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THE PRINCIPAL SERPENTS OF FRANCE.

FRANCE is inhabited by two kinds of serpents, one of which is entirely harmless and the other venomous and dangerous. The first comprises the adders and the blind worm and the second the vipers.

The adders are serpents with a slender body, a very long tail and oval flattened head covered with large scales, a round pupil and teeth that are fixed and smooth and not perforated. They have small poison glands, but cannot use them, for the reason that they have no fangs. The most common species are the ring adder (so called on account of the ring that it shows upon the neck) and the viperine adder, which at first sight bears a great resemblance to the viper. The adders lay eggs. They feed upon worms, insects, batrachians and small birds.

The blind worm is not a true serpent, but a lizard without legs. It is entirely harmless and renders great services by destroying insects. Its body is vermiform, with metallic reflections, and yellow beneath. Its head is conical and its eyes are small. The tail is longer than the rest of the animal, and when it gets broken it is reproduced.

The indigenous vipers comprise two principal species—the common viper and the small viper.

The upper jaw of the vipers is provided with a poison apparatus composed of two glands and teeth called fangs. These fangs, which are variable in number, are arranged on each side of the upper jaw. They are long, curved and sharp pointed and are provided with a central channel starting from the base and ending in a small orifice toward the point. The anterior tooth is the larger and is the true poison fang. It alone is connected with the conduit of the venom gland of the corresponding side.

THE RING ADDER.

The other fangs are so much the smaller in proportion as they are situated more to the rear. They are designed to replace the true fang when the latter gets broken or is pulled out. It sometimes takes but from three to four days for a broken fang to be replaced. As a usual thing, the fangs lie horizontally along the palate, with the point directed to the rear. Each of them is concealed in a membranous fold—a true scabbard which the mucous membrane of the mouth forms at its base. When the serpent opens its jaws for an attack the venomous teeth suddenly rise, and their fine, sharp point is thrown forward outside of the mouth. Woe to the victim, enemy or prey, that is struck by these venomous points! The poison that they deposit in the depth of the flesh soon enters the circulation and prevents the operation of the organs that are the most indispensable to life.

THE BLIND WORM.

The poison glands are located in the temporal fossæ. Each of them contains a small cavity in which venom accumulates and which performs the function of poison reservoir. It communicates with a small canal that opens at the base of the fang of the corresponding side. The poison, in escaping from the gland compressed by the muscles that cover it, flows directly into the canal and issues from the point of the fang.

The external characters that distinguish the vipers from the harmless serpents are the following: The vipers have a wider head, which is triangular and more distinctly separated from the neck. The body is thickset; the tail is short and conical and the pupil is vertical and linear. They feed upon living prey and are ovoviviparous. As soon as the eggs are laid, the young ones break the soft shell and emerge.

The common viper, the indigenous species, is the one that is most widely distributed and the most dangerous. It is sometimes aggressive, and although its bite is not always mortal, it is always followed by serious symptoms. The body, the length of which rarely exceeds thirty inches, is thickset and covered with imbricated scales. The back is marked longitudinally with a series of dark lines arranged in a zigzag manner. The head is sharply triangular and covered with small, smooth scales. It is provided with two brown lines that are arranged obliquely and form an angle with each other at the anterior point. The nose is blunt and even turned up, and the mouth is very wide. The jaws are powerful; the neck is markedly distinct, and the tail is short and abruptly terminates the body. The color of the common viper is very variable—gray, russet, black or brown.

The small viper is less aggressive and less dangerous than the preceding. It is of nearly the same length and same bulk, but has a slightly longer head, which is not so wide behind and less distinctly separated from the body. The nose is regularly rounded and does not turn up. In the middle of the head it is provided with three plates, and, within each eye, a plate that exceeds it in the rear. The color is variable, passing from gray to reddish or black. The back is always marked with a brown or black line, which is sinuous, as in the other species.

Vipers usually like rocky or sandy ground covered with heath and broom. They are found especially upon the borders of wastes and woods, in copses and also in the openings of great forests, at roadsides, in fields, and in old walls of dry stones, etc.

The common viper always lives in dry places. The small viper also prefers elevated places, but it readily accommodates itself to low grounds that are slightly wet and even swampy.

As a general thing, vipers do not like the presence of man, and soon quit ground that is given up to culture.

During the winter, these reptiles keep themselves concealed in subterranean excavations, under old stumps, in the interstices of rocks, in heaps of stones, in walls, in the burrows of moles, etc.

When the warmth of spring comes on (usually toward the middle of March), they awaken and leave their winter retreat.

During the month of April, and often at the beginning of May, they commence their travels, and the males seek the females. So at this season of the year they are generally not found isolated. They are often seen twined around each other in considerable numbers and thus form masses bristling with heads. They are generally very lively and aggressive and hiss loudly

THE COMMON VIPER.

at the approach of an enemy. It is at this season that they are most easily destroyed.

During the fine season the viper makes its exit daily from its retreat and coils upon the grass, moss or a pile of stones in order to await its prey or warm itself in the sun.

For making its exit from its place of refuge, the viper selects by preference certain hours of the day that vary according to the state of the sky and atmosphere. In midsummer, when it is very hot and dry, it shows itself in places well exposed to the rising sun, as early as seven o'clock in the morning, and remains in the full sunlight until eight or nine o'clock, and then, when the heat becomes excessive, it retires to the shade.

In the evening, just before sunset, the viper shows itself again at the same places that it did in the morning. It does not re-enter its retreat until nightfall.

POISON APPARATUS OF THE COMMON VIPER.

But when the weather, instead of being warm and dry, is cool and rainy or stormy, and when the sky is overcast, the viper stays outside all day. It is then seen coiled with its head raised in the center of the spiral. Thus it remains immovable for hours at a time, and seems little disposed to make its escape upon the approach of man.

In order to find these reptiles, serpent catchers make their way slowly along thickets and the borders of woods and explore the smallest details of the ground with their eyes. They are also often seen to stop and look in different directions, so as to put the serpents to flight in order to seize them.

Vipers never show themselves either upon trees or shrubs, but always remain on the ground. They sometimes place themselves upon large tufts of grass, upon fagots, and upon branches piled up on the ground.

The viper feeds upon living prey. In its stomach are found mice, rats, and small birds, or the debris of these animals. Unlike the adder, the viper does not seem to be fond of frogs and toads.

Toward the end of September the viper lays its eggs,

POISON FANG OF THE VIPER.

the young females laying from two to five and the old ones as many as fifteen. When they make their exit from the egg, the young vipers are about six inches in length, and are at this moment capable of biting, and are dangerous. If small birds are bitten by a viper a day old, they quickly succumb, poisoned by the venom.

In order to procure the venom of the viper, one may have recourse to several processes. The simplest and least dangerous consists in opening the jaws of a reptile that has just been killed, pressing the glands and receiving the drops of venom that exude from the tips of the fangs upon a very clean plate of glass or in a watch glass. Upon proceeding thus, it is very difficult to obtain much venom, since the viper, in defending itself, at the moment that it is put to death, generally empties its glands more or less completely. The following process gives the best results. It consists in exciting a living viper in order to get it to bite at an object that is presented to it. It may be made to bite at a spoon or a plate of glass; but in depositing its venom it often breaks its fangs. It is preferable to present to it a

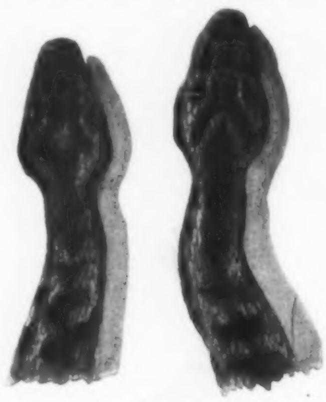
SECTION OF A FANG SHOWING THE CENTRAL CANAL.

piece of flat wood the extremity of which is covered with thick and very clean leather. In biting the leather it does not break its fangs, and deposits at each point of attack a drop of venom that is easily collected.

The viper never gives up its full supply of venom at one bite. In order to exhaust its glands it must be provoked several times in succession. After a few bites, and when the gland is exhausted, the bite is no longer dangerous. It is with vipers thus prepared that certain snake charmers cause themselves to be bitten in public without experiencing any symptoms of poisoning.

The pure venom may be preserved for a long time with all its activity. It has been found that the fangs of the viper preserved for several years and dried are still capable of causing grave symptoms if they are inserted into the flesh of an animal or if a person wounds himself with them accidentally. The pure venom is a light amber yellow gummy liquid that froths when it is shaken. It has neither odor nor taste.

Several persons have had the courage to put some of the venom into their mouths in order to see how it tastes. It is said that a certain person named Jacques, a serpent catcher, swallowed large quantities of it, even as much as a teaspoonful, and made the assertion that the venom is nearly insipid and has merely a slight taste of oil of sweet almonds. Several scientists have confirmed this fact by depositing fresh and pure venom upon the tongue, and even by swallowing it.



HEAD AND NECK OF THE SMALL VIPER.

The microscope does not permit of discovering any organism or germ in the pure venom. Its toxicity cannot, therefore, be attributed to microbes.

It acts through a chemical poison of albuminoid nature called echidnine or viperine.

The bite of the viper, which is always very dangerous, is often fatal to man and the majority of domestic animals—the dog, the goat, the sheep, and even the ox and horse.

Out of a hundred cases of the bite of this serpent, there are about fifteen fatal to man. In the departments of Vendee and Loire Inferieure, Dr. Viaud-Grand-Merais during the last twenty years has observed 53 cases of death out of 370 of bites. The common viper has much oftener caused death than the small viper. Sometimes death supervenes in one or two hours after the accident, and at other times in one or two days after it. In persons who recover, the health is often affected for a long time. They sometimes exhibit feebleness, syncope, hemorrhages, anæmia and stomach complaints for months, and even for years. Among animals, hunting dogs are the most exposed to venomous bites. The number of these animals that are annually killed by the viper is very large. Those that recover from the after effects of the bite remain unfitted for hunting. The sense of smell is blunted, the strength diminishes and they become anæmic and thin.

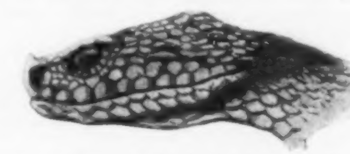
The conditions in which the bite is given are very varied. Man is oftenest bitten in the hand upon lifting a sheaf of wheat or gathering grass, leaves or

the head of a living viper into the mouth. Hunting dogs are oftenest bitten in the nose, lips, tongue and legs while they are in quest of game.

The viper cannot rise vertically upon its tail. When it strikes, its head is never lifted more than eight inches from the ground. It suffices, therefore, to wear boots or thick shoes in order to prevent one's self from being bitten.

The toxic effects of the venom manifest themselves rapidly; and, in most cases, at the very moment of the puncture, the man or animal feels a sharp pain that causes him to utter a cry. Then there supervenes a burning sensation that gradually extends and involves an entire limb and causes therein a sort of torpidity.

The dog struck in one of his legs raises it and avoids placing it upon the ground for fear of increasing the pain. But a few minutes elapse when the punctured



PROFILE OF THE HEAD OF THE COMMON VIPER.

point becomes surrounded with a violaceous aureola, and then the part swells. The swelling quickly increases and gradually reaches remote parts and sometimes extends over the length of the limb or over a large part of the body.

The parts touched by the venom quickly take on a livid color, and there forms in the first place, at the point of penetration of the fangs, a violet aureola, and red, blackish, violet colored or bluish blotches appear upon the entire surface of the congested part.

A man often becomes unconscious at the moment of the biting or a short time afterward. Such fainting fits are rather the result of fear than of pain. Then there surpervene a dazed state, a moral and physical prostration, pains in the stomach, colic, headache, a very painful sensation in the throat, nausea, vomiting, cold sweat, diarrhea, intense thirst, a yellowish coloration of the skin, somnolescence interrupted by cramps, convulsions, troubled dreams and delirium.

In persons who are not badly bitten, the symptoms of poisoning offer a less alarming picture. The symptoms are often limited simply to an indisposition, prostration, nausea, vomiting, the passing of blood and a greater or less amount of local congestion.

In animals, and principally in the dog, the phenomena that are observed after a bite are sensibly the same as in man.

In most cases, when the symptoms just described are dissipated, the patient completely recovers his health and later on no longer feels any distress. Yet sometimes abnormal phenomena are seen to appear that persist for several years, or that are periodically reproduced at certain epochs. Dr. Viaud-Grand-Marais expresses himself as follows:

"The convalescence is prolonged and is quite often complicated with anæmia and chronic achexia. Such symptoms correspond to a persistent and profound alteration of the general nutrition. The wounded person, instead of returning freely to health after the disappearance of the local and general symptoms, remains valetudinary and continues to decline. At other times there is a relapse. He has concluded that he is cured, and has resumed his habits of life, when, without any apparent cause, he becomes enervated and drowsy. He

METHOD OF COLLECTING VENOM.

flowers, or in introducing the hand into a hole in a wall, etc. He is bitten in the leg in stepping upon one of these reptiles with the feet poorly protected by shoes. Housewives are sometimes bitten upon picking up a fagot. Sometimes the viper creeps up under the clothes of people who are asleep and bites them on the breast, abdomen or thigh. Finally, the bites are sometimes the consequence of braggardism. Persons have been observed to permit themselves to be bitten in seizing a viper by the tail or by the neck, and others have been seen to allow themselves to be bitten on the tongue in order to excite astonishment by introducing

is without energy and strength, his temperature falls, his digestion is difficult and slow, and his skin becomes sallow. Adults grow old prematurely, and children are arrested in their development. Others, after an apparent cure of from a year and a half to two years, suddenly die after being attacked with cerebral troubles or pulmonary affections. In a certain number of patients there is observed a persistent weakening of the sight and hearing.

"But among the most singular facts indicated as following the bite of the viper must be particularly mentioned the periodical return, for a number of years,

of more or less intense suffering in the very place of the wound, and at the time of the year that it was inflicted."

These facts, witnessed by different observers, have, up to the present, received no satisfactory explanation.

The various local or general, immediate or remote symptoms are the result of the action of the poison upon the blood and the tissues of the organs. If the venom be prevented from entering the blood, either by bandaging the limb above the point bitten or by destroying the venom at the place where it is deposited, there is no phenomenon of poisoning observed.

Startling effects have sometimes been observed in man after being bitten, when the poison has been deposited directly in the interior of a vein by the fangs. When death occurs several hours after the venomous bite, it is often attributable to the invasion of the tissues by septic microbes. The tumor that develops at the place of the bite is favorable to the multiplication of putrid germs.

The venom is poisonous to man or animals only when it is deposited either in the live tissues or directly in the blood. Applied simply to the surface of the intact skin, it does no harm. It may also be applied with impunity to the eye or tongue, and may even be swallowed in considerable quantity without causing any indisposition.

Certain animals are refractory to poisoning by the venom of the viper—such, for example, as the serpents themselves, the adders and some other snakes, leeches, slugs and snails. There are other animals which, although not refractory, are but slightly sensitive to its action, such as the hedgehog. Upon the latter the bite of the viper does not produce much effect. This animal, nevertheless, is not refractory, but may succumb after several bites in succession. I have found that it requires but three drops of fresh venom injected subcutaneously to kill this animal.

Is it possible in case of a bite to counteract the terrible symptoms of poisoning? Different processes have been tried, such as a preventive and a curative treatment.

It has been shown by what precedes that certain animals are naturally refractory to the venom, and that others, without being absolutely refractory, are nevertheless not very sensitive to its action. It is established, on another hand, that the blood of such refractory animals is toxic and that it normally contains principles analogous to those of the venom.

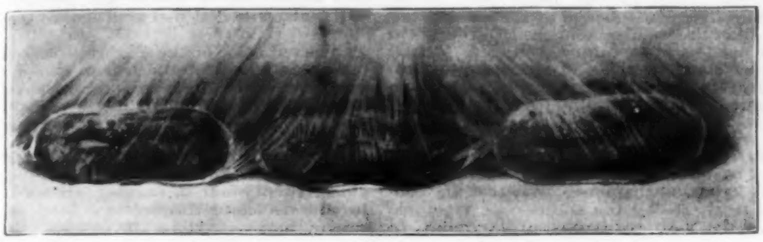
It has therefore been asked if, by inoculating man or animals with very small quantities of venom at certain intervals, immunity against mortal quantities could not be produced.

The possibility of conferring immunity upon man artificially is admitted in most countries in which venomous snakes exist. It is claimed that snake charmers allow themselves to be bitten by very venomous species without experiencing any symptoms. It is, in fact, possible to explain the slight danger of such bites by admitting that the serpents employed have been deprived of their fangs or of their venom, either because the poison glands have been extirpated or that the snakes have been made to bite shortly before.

In countries where there is a universal belief that certain snake charmers are not affected by the venom, the immunity is attributed to the fact that they swallow or inoculate themselves now and then with small quantities of poison obtained from the species of snake that they exhibit before the public. According to Mr. Moufflet, the following is the modus operandi in Guiana:

"Near here," says he, "there is an individual who is somewhat of a snake charmer, and whom people visit in order to get vaccinated. At his house he has in a box (a table drawer) a pot containing a small venomous serpent. Under any pretext whatever, as, for example, of offering a cigar, he will hand out the box. Scarcely has a person put his hand into it in order to grasp the object when he feels himself bitten. The snake charmer then administers a remedy. The bite is usually followed by three or four days of indisposition. Does this bite of a particular serpent give immunity relative to all others? I do not know. I wished to have the experiment tried upon myself, but the charmer would not inoculate me, because I was a white man."

Experiment alone would permit of judging of this question. Having inoculated several dogs with small quantities of the venom of the common viper, I found that after a certain number of injections, the resistance of animals to the poison increased. The local effects still exhibited themselves in these vaccinated animals, but the general symptoms remained always greatly moderated. In them the venom no longer produced nausea, vomiting or hematuria, but simply a slight depression of spirits. These experiments have taught me that it is possible to confer upon animals, and probably upon man, a greater resistance to poisoning, through successive inoculations, at properly spaced intervals, of very small quantities of venom.



EGGS OF THE VIPER BEFORE OVIPOSITION.

A further progress was made but a short time ago. It was found that the venom of the viper, heated for a few minutes to 80 degrees, loses its toxic properties in a great measure and becomes even a vaccine matter. When animals are inoculated with this heated venom, they are not only not made ill, but there is conferred upon them a certain resistance to toxic quantities of venom with which they are afterward inoculated. Unfortunately, such vaccination produces effects of but short duration.

Experiment has permitted of ascertaining that different principles exist in the venom—some of them toxic and destroyed by heat or certain chemical agents, and others harmless, but having the property of rendering animals refractory to the effects of the entire venom.

Another important fact has been established. When blood or serum is taken from an animal that has been rendered refractory through the inoculation of venom, and is treated by heat and then injected into animals, the latter become refractory to the action of the active venom.

The injection of such serum has been tried as a therapeutic medium for combating the symptoms that have already begun to exhibit themselves. In order to obtain success, however, it is necessary to have recourse to the treatment in less than half an hour after the accident.

Serotherapy, which at first seemed to promise so much, gives in practice, therefore, only uncertain results. So it oftener becomes necessary to have recourse to other means. The first thing to be done after a bite is to extract as much venom as possible from the wound. To this effect, the simplest means is to apply strong suction to the small aperture made by the fangs. In order to facilitate the removal of the venom, it will be necessary, after the first suction, to incise the tissues at the place where the fangs have entered and apply a tight ligature between the heart and the place bitten. After the application of the ligature, as much blood and serum as possible should be extracted from the wound by pressure and suction. These simple means often suffice to prevent grave symptoms. Still, as some of the venom always remains in the tissues, it is well to introduce into the wound certain substances that have the property of destroying the venom, such as permanganate of potash or chromic acid, which are really efficient substances, the use of which is attended with no danger. These two substances employed in a one per cent. solution have a double advantage. They destroy the poison that they touch and at the same time disinfect the wound and prevent a secondary microbian infection.

FIGHT BETWEEN A HEDGEHOG AND VIPER.

But it is better to prevent than to cure, and the best means to prevent accidents is to get rid of the snakes. To this effect the multiplication of animals that are reputed to destroy snakes has been proposed. Among such animals, the only one that merits attention and protection is the hedgehog. In order to have the spectacle of a fight between a hedgehog and a viper, it suffices to put these animals in the presence of each other in a cage or a tub. The hedgehog will be seen to immediately start for the serpent in concealing its head under its spiny helmet. The viper, in a position of attack, watches its enemy, and as soon as the latter approaches, begins to hiss and then strikes him several times on the spines, and thus uselessly exhausts its venom. The hedgehog then seizes the snake, kills it and immediately bites off and devours its head.

Of all the methods of destruction proposed, however, the best and most efficacious is the one that consists in offering a bounty for every viper destroyed.

M. KAUFFMANN.

ON CERTAIN VESTIGIAL CHARACTERS IN MAN.

SEEING that Prof. Huxley, with his well known candor, felt constrained to admit that the study of rudimentary or vestigial characters had done more than that of any other class of facts to produce general acceptance of the doctrine of evolution, and that at the same time he acknowledged the double-edged nature of these characters, it is not out of place to appraise the evidential value of certain of them.

The direction of the hair slope on three regions of the body, as bearing upon the simian ancestry of man, will be first considered.

1. On the upper extremity of man the direction of the hair slope, which may, for the sake of brevity, be called the Human Type, is as follows: On the upper arm the slope is all downward to the elbow, with a slightly oblique direction on the anterior surface. This direction appears to be the same as that in all the monkeys examined.

But on the forearm the human type is as follows: On the flexor surface the stream of hair divides and passes obliquely to the radial and ulnar borders respectively, and to the carpus. On the extensor surface the slope continues on the radial side in a direction at right angles to the long axis of the limb, and gradually curls backward over the posterior surface of the ulna, joining a corresponding "backwash" of the stream of hair from the ulnar border. Thus, on a small area amounting to about a fourth of the extensor surface, the united stream of hair passes directly to the elbow.

This description is based upon the examination of numerous forearms, hairy and non-hairy, of infants a few days old and three months old, of children from seven to fourteen years old, of adults male and female—among the adults five very hairy male subjects. In all of these forearms, as far as the scanty hair on some would allow one to observe it, there was very little departure from the Human Type as described. In the cases of infants the hairs were very minute, and required a lens to reveal them. The direction stated is easy to verify or to disprove; but it is surprising to find such a statement as occurs in "Darwin and After Darwin," by the late Prof. Romanes, where, on page 89, he says, "again, in all men the rudimentary hair on the upper and lower arm is directed toward the elbow—a peculiarity which occurs nowhere else in the animal kingdom, with the exception of the anthropoid apes and a few American monkeys. . . ." With this statement Prof. Romanes and Prof. Drummond seem to have remained satisfied, though their own forearms, and those of every person they might have examined, would have told a different tale, either with or without the assistance of a lens. The statement of Prof. Romanes clearly refers to the permanent hair of the body, as shown by his illustrations, and not to the lanugo or temporary hair.

The direction of the hair slope on the forearm of the anthropoid apes—the anthropoid Ape Type—is certainly what is stated by Romanes and Drummond, viz., toward the elbow, with a slightly lateral direction both on the flexor and extensor surfaces, except in the orang, in which the slope is all directly to the elbow. This is to be seen in all the anthropoid apes at the Zoological Society's Gardens, London, in the case of the gorilla, chimpanzee and gibbon hoolock, and in the case of the orang at the Natural History Museum, South Kensington, where also the slope of the hair on the forearms of gorilla, chimpanzee and gibbon is confirmed. St. George Mivart* mentions one species of gibbon, Hylobates agilis, where the Human Type appears to be exceeded in the wristward direction. He says, "in Hylobates agilis all the hair of both these limb segments is directed toward the wrist."

This statement is not fully borne out by the examination of the specimens of Hylobates agilis at South Kensington.

In addition to these four genera of anthropoid apes, twenty-two other species of monkeys were examined as to the slope of the hair on the forearm, with the following results:

A 19. Catarhine or Old World monkeys, as follows:
- 13. Human type, viz.:
  - Cercocebus æthiops, Barbary ape, Japanese ape, Cercopithecus campbelli, Cercopithecus ruber, Cercopithecus diana, Cercopithecus callitrichus, Cercopithecus lalandii, Cercopithecus griseo-viridis, Cynocephalus anubis, Macacus maurus, Arabian baboon, Cercopithecus abigulosus.
- (1) Anthropoid Ape Type, viz.:
  - Cercopithecus cephus.
- (5) Partial Human Type inclining to Anthropoid Ape Type, viz.:
  - Cynopithecus niger, Cercocebus fuliginosus, Macacus cynomologus, Macacus rhesus, Macacus sinicus.

B (3) Platyrhine or New World monkeys.
- (2) Human Type, viz.:
  - Cebus fatuellus, Cebus monachus.
- (1) Anthropoid Ape Type, viz.:
  - Ateles geoffroyi.

Thus of twenty-two lower monkeys, Old World and New World, fifteen very closely resemble the human subject in this small morphological character, whereas all the anthropoid apes (one species of one genus ex-

* Encyclop Brit., vol. ii, p. 157.

cepted) are markedly different from the Human Type.

Such things ought not to be on the theory of the descent of man from the ape. They may not alone support the opposing theory, but they ought never to have found their way into valuable and popular books, being selected from a great array of so-called vestigial characters with a view to supporting the above theory.

2. There is no reason why the direction of the hair slope on the forearm should be studied in its vestigial character, any more than that on the thigh. On the thigh the Human Type is as follows: On the flexor surface the hair slopes in two streams to the outer and inner borders respectively, and toward the knee. At the upper third and outer side the slope takes a direction at right angles to the long axis. On the extensor surface the streams of hair which come from the borders coalesce and pass to the back of the knee. The Simian Type is oblique, and to the pelvis, i. e., in the favorite position of the monkey, when sitting on its haunches, the hair falls quite vertically downward. This statement is based on the observation of the four anthropoid apes and twenty-seven other lower monkeys, including the twenty-two previously specified, thirty-one in all. There were found, out of these thirty-one specimens, ten partial exceptions, five American monkeys, and five lower Old World monkeys, such as baboons, Barbary ape and Japanese ape. In these ten there was a slight resemblance to the Human Type, but not a vestige of resemblance in one of the anthropoid apes examined.

3. A third region of the human body shows the divergence between the Human Type of hair slope and the Simian Type even more strongly. On the dorsal surface of the trunk in man, in the erect posture, the hair slopes in the supra-scapular region inward and at a right angle to the middle line, on approaching which it curls downward. Below the spine of the scapula the same direction obtains until about the level of the angle, when the hair slopes upward and inward to a point over the transverse processes of the vertebra, where it becomes horizontal and then curls sharply downward, joins the stream of hair from the opposite side, and passes vertically downward in the hollow over the vertebral spines. This Human Type I have found constant in children and adults, and it differs strikingly from that of all the apes and monkeys examined, in which, without exception, the hair slopes as nearly as possible vertically downward, when the animal is sitting.

These remarks, calculated to disparage the value of the direction of the hair slope on the human body as a "vestige" of his descent from the ape, may be met in two ways at least. In the first place, one may be reminded that it is not to the few existing anthropoid apes, "living fossils," indeed, but to some unknown dead fossil apes of the Miocene period that we must look for the direct ancestry of man, and that the difference in the hair slope pointed out is consequently unimportant. Perhaps it is. But the supposed resemblance was thought worthy of prominence in the works of evolutionists, and accordingly the ascertained divergence is worthy of not less prominence.

In the second place, the differing hair slope on the forearm, thigh and back of man and the anthropoid apes may be explained by the possible influence which the greater weight of the long hair covering the bodies of apes would have in producing a generally vertical direction of hair slope in the sitting posture. This posture, doubtless, is the one in which far the greater part of the life of the ape is spent, and a little consideration of the position of an ape in sitting will show that gravitation would tend in the case of long haired apes to produce the Anthropoid Ape Type on the forearm, thigh and back. In the case of man, the action of gravity would be unable to influence the slope of his short rudimentary hairs. This suggestion of a possible cause contributing to the hair slope on the bodies of apes has, however, no bearing on the question of fact. It may be an explanation, but the facts remain.

Thus man in these characters resembles much more closely the lower Cercopithecidæ and Cebidæ than his supposed nearest congeners, at present existing. It is also incorrect to assert that only in man, a few American monkeys, and the anthropoid apes, does the hair slope toward the elbow. This Human Type is seen in the corresponding area of this segment of the anterior extremity of almost all hairy mammals, excepting most of the Ungulate types, and those with woolly hair. It is found very constantly in Carnivores, especially those which frequently rest in a "couchant" attitude, in which the head is held erect, the forelimbs planted in front of the body, and the extensor surface of this limb segment resting flat on the ground, also in certain other positions of rest; and it can be seen in nearly all wild Carnivores and domestic cats and dogs. In those Carnivores which assume this attitude the posterior limbs adopt a much more variable "pose," and here there is no constant form of hair slope. The backward curl of hair on this narrow area of the forearm in man, certain monkeys and many other hairy mammals, seems to be due to a mechanical force, slowly acting downward and forward, which makes for this direction of hair slope. In all these three classes it is obvious that such pressure is frequent. This explanation of an inherited character, maintained by a simple physical cause, meets the case far better, I submit, than any supposed tracing out of ancestral vestiges.—Walter Kidd, in Nature.

IS ANIMAL LIFE POSSIBLE IN THE ABSENCE OF BACTERIA?

SOME ten years ago Pasteur, in one of those "causeries du laboratoire" which those who were privileged to take part in will never forget, discussed with the young scientific men around him the interest which would attach to the nourishment of an animal from its earliest existence with sterilized food under conditions which would insure the absence of all microbial life. "Sans vouloir rien affirmer," he added, "je ne cache pas que j'entreprendrais cette étude, si j'en avais le temps, avec la pensée préconçue que la vie dans ses conditions deviendrait impossible. . . . Que le résultat soit positif et confirme la vue préconçue que je mets en avant ou qu'il soit négatif et même en sens inverse, c'est-à-dire que la vie soit plus facile et plus active, il y aurait un grand intérêt à tenter l'expérience."

To decide this question Messrs. George Nuttall and H. Thierfelder have carried out elaborate experiments in the Hygienic Institute of the Berlin University with young guinea pigs removed from the mother by means of the Cæsarean operation. Every conceivable precaution was taken to prevent all access of bacterial life. The young guinea pig was placed in a sterilized chamber, supplied with sterilized air, and it was fed exclusively upon sterilized milk. It had to be supplied with food every hour, day and night, a process which so exhausted the investigators that at the end of eight days, when it had consumed 330 cubic centimeters of milk and to all appearances was in perfect health and spirits, it was killed.

A microscopic examination of the contents of the alimentary canal revealed no bacteria whatever; ærobic and anærobic cultures in various media were further made of the intestinal contents and of the excreta, but in every case the culture tubes remained sterile, not a single colony made its appearance. Messrs. Nuttall and Thierfelder claim by these experiments to have proved conclusively that the presence of bacteria in the alimentary canal is not essential to vital processes, at any rate in the case of guinea pigs; and they consider themselves justified in assuming that other animals, and also human beings, could similarly exist in the absence of bacterial life as long as the food supplied is purely animal in character. Whether the conditions would be altered by the addition of vegetable food to the diet they next endeavored to determine. In this series of experiments the food selected was so-called "English" biscuits containing about 7 per cent. nitrogenous material, 9 per cent. fat, 17 per cent. sugar, 58 per cent. of other non-nitrogenous matters and 0·2 per cent. cellulose; these, together with the milk employed, were sterilized before use. The same rigorous precautions characterized these experiments as the previous ones; more animals were, however, secured, and they were allowed to live longer. The weight of the animals was this time carefully noted, and during the ten days during which the experiment lasted, one animal gained 23 grammes and another 11 grammes. This calculation could only be an approximate one, as the experimental animals were not weighed when originally removed from the mother, and their initial weight was only arrived at by weighing the other guinea pigs which were removed at the same time, but not experimented upon. Thus in the case of vegetable substances bacterial life is apparently also not essential for carrying on digestive processes. The authors made also as careful an examination as was possible with the limited amount of material at their disposal of the urine, and state that aromatic oxyacids were undoubtedly present. This result they regard as confirmatory of E. Baumann's assertion that aromatic oxyacids may be elaborated independently of intestinal decomposition. To this point they intend, however, to return later; at present further investigations are in progress with fowls, and the results will be awaited with the greatest interest, while immense credit is due to the authors for the ingenuity of the methods they have devised and the self-sacrificing laboriousness with which they have conducted the experiments.—Nature.

THE GROTTOES OF JONAS.

ONE of the localities of Auvergne oftenest recommended to tourists is the curious little town of Besse-en-Chandesse, where historic souvenirs are so picturesquely materialized by a collection of carved houses, each of which is a gem. Lovers of nature can, on their part, make Besse the center of a long series of excursions of great interest, among which may be recalled here a visit to Lake Pavin, which is of so dramatic beauty, an ascent of the peak of Sancy, the highest observatory of Central France, and, in another direction, a run to Lake Chambon and Murols Castle, which are illustrated by the incomparable descriptions of George Sand.

It is near Besse, too, that we find the grottoes of Jonas.

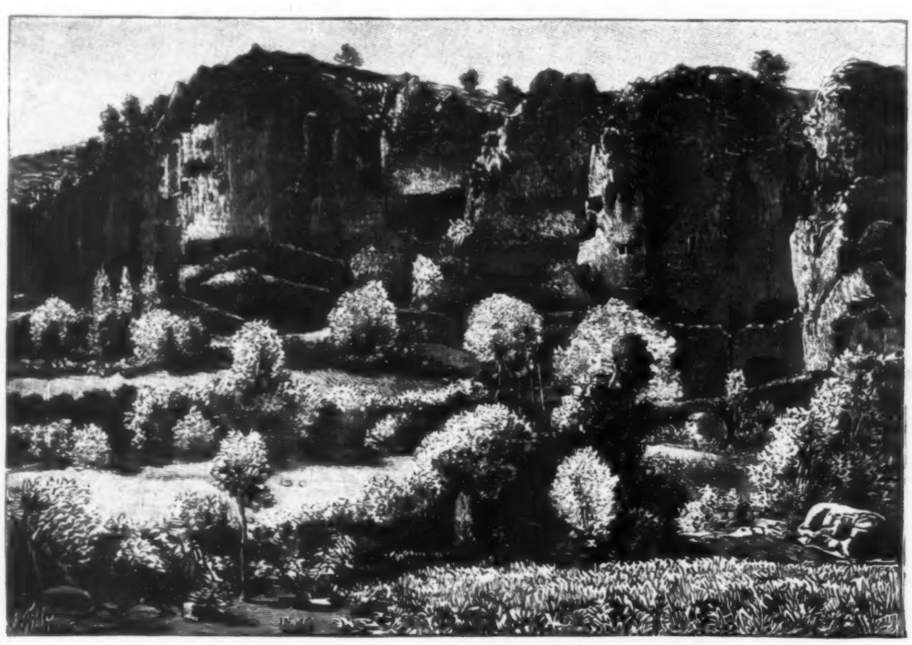
They are fully worth the trouble that has to be taken to reach them. When we leave the town we have to traverse a region that is essentially basaltic, and near Saint Diery and Crest affords picturesque escarpments. Even at the Puy de Treuil a true colonnade exhibits itself. Overlooking the surface of the but slightly broken environs stands in the distance the huge form of the Puy de Saint Pierre Colamine, which serves as a pedestal, at an altitude of 3,300 feet, for a small church from which the view is very extensive.

There are few points in Auvergne that are more volcanic in appearance. On all sides there are piles of scoriæ that are of odd form and striking in color, which varies from deep black to blood red, in passing through various intermediate shades. Deposits of lava, and especially those of the Puy de Monteineyre, at the foot of which is Lake Pavin, make the ground undulating with their "cheires," which are rebellious to culture. Piles of conglomerate, greatly varied in their elements, extend over a wide area.

It is in this category of rocks that the Grottoes of Jonas have been formed. These rocks form coarse beds superposed in layers that are scarcely parallel with each other, and that abut against the Puy de Saint Pierre.

"The red color of these scoriæ," says Henri Lecoq, "the pure yellow of the lichens that cover them in some places, the fresh verdure of the cedars, and the rapid flight of the rock swallow, which has fixed its abode in this solitude, make a very remarkable and picturesque place of it."

But what makes the locality exceedingly strange is the presence of the grottoes, the yawning mouths of which, twenty-four in number, are seen from a great distance detaching themselves in black from a vertical wall of rock. Despite the abrupt appearance, the ascent is not difficult, and we even meet with true winding stairs in a perfect state of preservation, and, thanks to these, the exploration can be effected very easily. As shown in the accompanying figure, the grottoes are at various altitudes above the plain (30, 40, 50 and up to 100 feet), and they differ also by their very unequal sizes, from that of a small hut up to that of a huge hall in which more than a hundred persons might stand with ease. Here and there the walls are decorated with ornaments, and one hall, considered as having been a chapel, has its walls painted with frescoes that are interesting, if not of high artistic merit.



GENERAL VIEW OF THE GROTTOES OF JONAS, NEAR BESSE, IN AUVERGNE (FRANCE).

Antiquarians are sufficiently in accord to refer a portion at least of this work to the thirteenth century, but they are not agreed as to the true purpose of these singular cavities. Thus, according to certain learned men, those who made these excavations were the Templars, who proposed by this gigantic work to convert the rock of Colamine into a citadel. "It was," says the anonymous author of a work entitled "Vacations in Auvergne" (1857), "the most curious retreat and the greatest wonder in the world. It was reached of old by a drawbridge that must have been over ninety feet above the surface, judging from the openings of the main entrance. Four superposed stories communicate with each other by winding stairs, carved by hand in a mass of rock. The apartments were lighted by round openings that had been formed in the basalt. There are still to be seen the hall of arms, the dining hall, the kitchens, the stables and the mangers for horses. But what is most remarkable and well preserved are the chambers of the knights and the chapels, which still bear traces of the purpose for which they were designed. This fortress, which seems as if it were the work of the Titans, has been deserted for ages, and it has occurred to no one to use it except as a hayloft."

Other authors think that it is a question of a true subterranean village, and this is the opinion of Mr. Lecoq, who has written a magnificent work in five large volumes, entitled "The Geological Epochs of Auvergne." In this case, we would be in the presence of vestiges due to some of those singular troglodytic people known in America by the name of cliff dwellers, and of which we have specimens in several regions of France, as in Touraine, for example.

The ruins of the subterranean village of Jonas were probably the consequence of a downfall, a sort of accident very frequent in rock of the kind in which the grottoes are formed. An example of these, among others, is seen at Pardines. Wide fissures traverse the rock, and every year during a thaw pieces become detached, so that these venerable remains will be gradually destroyed, until nothing is left but the remembrance of them.—La Nature.

THE INTELLECTUAL CAPACITY OF WOMAN.

IN order to ascertain the intellectual capacity of woman, her brain must be studied and compared with that of man. The most distinguished anatomists and physiologists have, for several years past, been exhibiting a predilection for researches in this direction, but it was reserved for Prof. Darkchevitch, a young Russian scientist, who has devoted himself especially to this comparative study, to reach a definite solution of the question. In a lecture recently delivered by him at the annual meeting of the Société des Psychiatres, of Moscow, he scientifically demonstrated the equality of the intellectual capacity of the two sexes.

The Russian professor proposes the following question: Does the organization of woman present conditions that necessarily render her less capable of intellectual development than man?

Up to the present, misogynists have always triumphed by invoking, in favor of woman's inferiority, the indubitable fact that man's brain weighs, on an average, 135 grammes more than the brain of woman.

Bischoff, the celebrated anatomist, says, word for word, in his treatise upon the weight of man's brain: "We cannot deny that man has everywhere and always distinguished himself by greater intelligence and greater intellectual capacity than woman, since the brain of man has always and everywhere possessed a weight greater, by from $\frac{1}{8}$ to $\frac{1}{11}$, than that of the brain of woman."

Another anatomist finds a great difference between the brain of man and that of woman, but remarks that the more civilized the race is, the more marked is such difference. Thus, among the Australians, the cranial capacity of man exceeds that of woman by 107 cubic centimeters. Among the ancient Egyptians, who were much more highly civilized than the savages of Australia this difference is 137 cm., while among the Parisians it reaches 222 cubic centimeters. Have these facts, demonstrated by science, the significance that misogynists attribute to them? Prof. Darkchevitch disputes this through the aid of the following solid arguments.

Man, says he, is undoubtedly the most intelligent of animate beings. Therefore, if the weight of the brain gave the measurement of the intellectual development of the individual, the weight of the human brain would be greater than that of any other animal, and that too without exception. Now, here is what we find upon examining the following table of the absolute weight of the brain of different animals and of man:

Cat	28	grms.
Dog	80	"
Sheep	120	"
Lion	250	"
Gorilla	400	"
Ox	500	"
Horse	650	"
Man	1,360	"
Whale	2,800	"
Elephant	4,600	"

The brain of man weighs more than that of the majority of animals, even of those which, like the ox and the horse, have a larger and heavier body. But, on another hand, the brain of man weighs less than that of the whale and elephant.

Should we conclude from this that the whale and the elephant have an intellectual development superior to that of man? No; assuredly not.

Then why claim that such anatomical distinction implies the superiority of man's intellect over that of woman?

Another fact intervenes to annul the significance that misogynists ascribe to the difference in weight of the brain of man and woman. It has often been found that the brain weight of people who have exhibited great intelligence was sensibly less than that of persons whose intellectual development was considerably lower. Thus, Dr. N. Zernoff, a Russian professor, had occasion to weigh the brain of the celebrated Gen. Skobeleff, whose military talent, high culture, and wonderful energy are doubted by no one. Well, the brain weight of this distinguished man was less than that of forty simple soldiers, the brains of whom were weighed under the same conditions.

In the table of the brain weights of illustrious men drawn up by Bischoff we remark that the brain of the celebrated chemist Liebig was below the average as regards weight; and the same is the case with the brain of Doellinger (the well-known leader of the Old Catholic movement), which weighed but 1,207 grammes.

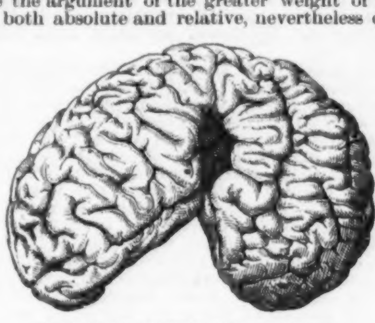
But one may, again, offer the following objection: The absolute weight of the brain, no doubt, cannot give us the measurement of the physical activity of the individual, that is to say, of his intellectual and moral activity. The human brain is not only the organ of psychical activity, since somatic activity* also is dependent upon it, and the more the organs of such activity are developed, the larger should be the brain. It is therefore evident that the brain of animals such as the whale and elephant must weigh more than that of man, not on account of greater intellectuality, but on account of the vaster superficies that the bodies of these animals present. This is why anatomists have so long endeavored to prove that the brain of man is relatively heavier than that of animals; and this relative superior weight of the human brain has been considered as the index of his intellectual superiority.

Such proof does not bear examination, since, if the weight of the human brain is relatively greater than that of the ox and elephant, it is relatively inferior to that of certain birds, such as the sparrow, for example, or to that of certain monkeys, such as the chimpanzee. The following table shows the ratio between the weight of the brain and that of the body:

Tortoise	$\frac{1}{2240}$
Ox	$\frac{1}{550}$
Elephant	$\frac{1}{500}$
Baboon	$\frac{1}{150}$
Macaco	$\frac{1}{90}$
Man	$\frac{1}{40}$
Sparrow	$\frac{1}{25}$
Chimpanzee	$\frac{1}{20}$

It is made evident by this table that, in taking the relative weight of the brain as a measurement of intellectuality, we find the same contradictions that we did when we took the absolute weight of the brain as a measurement. Moreover, in the question that concerns us, this test, were it acceptable, would serve for the triumph of feminists. It is an acquired fact that the relative weight of the brain is greater in woman than in man. According to Bischoff, the relative weight of the brain of man is [illegible] and that of woman [illegible].

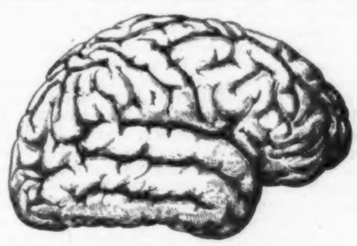
But the misogynists who are vanquished when they invoke the argument of the greater weight of man's brain, both absolute and relative, nevertheless do not



BRAIN OF THE ELEPHANT.

give up, but reply: We admit that the weight of the brain signifies nothing, but what indicates intellectual superiority are the convolutions of the surface of the brain, which are fewer in woman than in man.

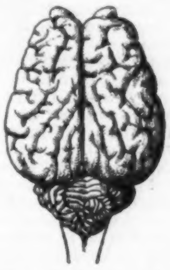
In order to judge of the value of this objection, we must, before all else, ascertain what ratio exists between the intelligence of the individual and the convolutions of the brain. We see, in fact, that fishes, reptiles and birds have a smooth brain. Many mammals exhibit no convolutions, while in the elephant they are very numerous, and still more so in the anthropoids, and reach the maximum of their development in man.



BRAIN OF MAN.

It has been concluded from this that the multiplicity of the convolutions is a certain mark of intellectual development; and then, since these convolutions do not exhibit the same form in man and woman, several scientists have hastily concluded that this is a proof of the inferior intellectual development of the female.

But comparative anatomy here intervenes once more to give the lie to this theory. In studying the form of the brain of certain animals, it has been discovered that the brain of the beaver (the animal so renowned for its ingenuity) is entirely smooth, while that of the sheep, which is more appreciated for its gentleness than its



BRAIN OF THE SHEEP.

intelligence, exhibits a great wealth of convolutions. How is this anomaly to be explained? Everyone knows what skill and what spirit of invention the beaver displays in the construction of its dwelling. It is an emerited engineer.

So, too, the brain of the elephant is infinitely richer in convolutions than that of man. The elephant is certainly one of the most intelligent of animals, but it cannot pretend to rival man in this respect.

Finally, upon examining the brain of celebrated persons, scientists have been surprised to find that the convolutions were less in them than in the brains of very

BRAIN OF THE BEAVER.

ordinary men. Prof. Zernoff, of whom we have already spoken, apropos of the weight of Gen. Skobeleff's brain, writes as follows: "After examining the forms of the convolutions of the general's brain, I found that all the peculiarities that I remarked have been observed in the brains of very ordinary men. It must be concluded from this that the great talent and intellectual development of Gen. Skobeleff had no influence upon the convolutions of his brain."

It is therefore impossible to establish any ratio whatever between the form of the convolutions of the brain and the intelligence; and so the second argument of misogynists is demolished.

Some scientists have thought that there was a relation between the development of the frontal lobes and the degree of the intelligence. Science has not as yet given serious data as to the psychical function of this part of the brain, but should it ever be proved that the intelligence is proportionate to the weight of the frontal lobes, the discovery would be in favor of the intellectual equality of the sexes, since, according to Bischoff, the weight of the frontal lobes of woman, far from being less than that of the frontal lobes of man, is greater.

Prof. Darkchevitch presents a new measurement of the intellectual development of the individual. He thinks that he has found this in the ratio between the weight of the brain and that of the spinal marrow. The spinal marrow is that part of the central nervous system that exclusively governs the somatic sphere and remains extraneous to the psychic sphere. The spinal marrow is, through its structure, a direct reflection of the structure of the body, but at the same time it is in relation with the brain, where, so to speak, it projects the parts of the body with which it is in contact. Thus, the brain, in addition to elements whose function is psychical, contains others that have merely a somatic function. The number of these latter elements must doubtless be in direct relation with the degree of development of the spinal marrow.

It is evident that the ratio between the weight of the brain and that of the spinal marrow would have been the same in all animals had not the brain contained elements that do not belong to somatic life and are in direct ratio with the psychical functions. It is to the presence of these elements that is doubtless due the difference in the ratio of the weights of the brain and spinal marrow. And, what is a curious thing, and what seems all in favor of the Russian professor's theory, is that the results obtained in trying to ascertain the relation between the weight of the brain and that of the spinal marrow correspond perfectly with the idea that we conceive of the intelligence of animals.

The following is a table of the ratio of the weight of the brain to that of the spinal marrow:

Tortoise	1·0
Cock	1·5
Pigeon	2·5
Sheep	2·5
Ox	2·5
Horse	2·5
Lynx	3·0
Cat	3·0
Dog	5·0
Seal	5·0
Mole	6·5
Hedgehog	7·0
Man	49·0

It is truly very curious to see that in this table man alone occupies so high a rank, and that he distances all other animals in so brilliant a manner. Although the Russian professor has not been able to give the exact figure of the ratio of the weight of the brain and spinal marrow in the whale, elephant and chimpanzee, he thinks that he can determine by analogy that it would be 10·0 in the whale, 18·0 in the elephant and 15·0 in the chimpanzee.

We see that everything concurs toward making us accept the new formula of the Russian scientist as best expressing the degree of intellectual development of the individual.

Now let us apply this formula to the question that concerns us—the difference of the intellectuality of man and woman. According to the anatomist Bischoff, the weight of the brain of man is 1,398·25 and the weight of the spinal marrow is 28·25. The ratio between the weight of the brain and that of the spinal marrow would therefore be 49·4. According to the same anatomist, the weight of the brain of woman is 1,300·25 and the weight of the spinal marrow is 26·37. The ratio between the two would therefore be 49·3.—Michel Delines, in Revue Encyclopedique.

NOTE ON THE ORIGIN OF MALACHITE.*

By EDGAR HALL.

IT is now generally conceded by mineralogists that the oxidized portions of mineral lodes represent merely the weathered condition of the originals, and that the oxide, carbonate and sulphate minerals contained therein have been formed by atmospheric influences alone. Very few men of experience in the everyday working of mines now think those influences to have been abnormal at any time. All the phenomena can be explained by the changes which are still going on, and present atmospheric conditions are ample to produce the weathering seen at the largest of mines. Such being the case, abandoned mines offer an interesting field of study to a mineralogist, as their workings expose large surfaces to the action of air and water.

Numerous as are the abandoned mines of New South Wales, the number available for examination and likely to yield valuable information is small. This is due to two reasons: one is, that the mines have not been abandoned long enough, and the other, that most of the mines are situated in the eastern coast ranges, where the rainfall is high, and, consequently, the mines get filled with water to a point very near the surface. It is obvious that a comparatively arid climate, or one where long periods of dry weather alternate with intervals of heavy rainfall, is required to produce large masses of oxidized ore bodies. Such a climate obtains in our far western districts, and accounts for the large bodies of oxidized ores found at Broken Hill, Cobar and other well known places.

In such a climate oxidation proceeds very rapidly. Iron pyrites where occurring in large quantity will, in four or five years, produce such a plentiful crop of crystals of iron sulphate that the sides and floor of a drive will be covered as if by snow; so much so, that the sound of one's footfall is muffled as one proceeds.

The writer had occasion, a short time ago, to visit the abandoned workings of a copper mine, and the observations made there are the subject of this note. The mine in question is situated at Girilambone, in the western part of the colony, about 100 miles from the Darling. The ore occurs as a copper bearing schist,

* Somatic activity comprises the motions of the limbs, trunk and locomotive apparatus.

* Royal Society, New South Wales.

and where unaltered is a bluish micaceous rock, carrying strings and blebs of a pyrite poor in copper. Permanent water stands at a depth of 180 feet; above this level the rock is soft and weathered, and the copper occurs as azurite and malachite, with a little oxide of copper. Copper glance is said to have been found there in the early days.

The azurite and malachite occur mainly as nodules of varying size; these are not pure carbonate of copper, but are earthy, and consist of portions of schist which have been saturated with the mineral. Malachite occurs also as narrow strings of pure carbonate of the fibrous variety. It is to this I wish to draw particular attention.

Between the surface and water level a great deal of excavation has been made in the schist, and these excavations can now be examined in safety. Most of them have been standing so for thirteen years past. The workings are very dry and crystals are not very plentiful, but in one crosscut, where there appears to be a drainage channel, the sides and roof are covered with particularly fine and long crystals of sulphate of copper and sulphate of iron, some of the cystals being an inch and a half long.

Further investigation showed that the schist in the crosscut was full of crystals of copper sulphate. The crystals had formed in the foliation planes of the schist, and were closely packed bundles of very fine fibrous crystals, completely filling the fissure. In most cases the crystals were at right angles to the sides of the fissure, but in some cases the fibrous crystals had become curved, and had forced a layer of schist outward into the drive. The crystals were of a brilliant blue color, and, of course, were very brittle, but in other respects the resemblance to fibrous malachite as seen in the schist at other places in the mine was complete.

The resemblance at once suggested the origin of fibrous malachite, namely, that it is a pseudomorph after sulphate of copper. The ordinary text books of mineralogy seldom hint at the method of formation of minerals, and in the case of malachite the writer has, so far, been able to find only one explanation of its formation. Frank Rutley* suggests that the mineral "has, in most cases, resulted from the percolation of water through copper bearing rocks, and the subsequent deposition of the dissolved carbonate in fissures and cavities." This explanation seems improbable in view of the insolubility of copper carbonate. Watt † states that the basic carbonate requires a pressure of four to six atmospheres for solution in water containing carbonic acid. Such pressures are impossible under natural conditions at the short distance from the surface within which malachite is found. The deposition from solution also presupposes the formation of the carbonate from the chalcopyrite which must have formed its starting point, and this presents equal difficulties.

The production of sulphate of copper from cupreous pyrites is the first and simplest result of oxidation, and from sulphate of copper any soluble carbonate will, at ordinary temperatures and pressures, produce a basic carbonate of the composition of malachite. Verdigris, the product of slow oxidation of metallic copper in moist air at ordinary temperatures, also has the composition of malachite, but it is hardly likely that the alteration of cupreous pyrites will follow that route.

Given the oxidation of cupreous pyrites by surface influences and the formation of fibrous crystals of sulphate of copper in cavities of a lode during a prolonged period of dry weather, it is easy to understand that during an ensuing period of wet weather, the descent of waters from the surface charged with carbonic acid and carbonate of lime will change the sulphate crystals into malachite; and that this alteration will proceed without change of form is highly probable. That this has been the mode of formation of the fibrous malachite in the cupreous schists of Girilambone, the writer has no doubt whatever, and he believes that the explanation will hold good for all occurrences of the mineral.

The following is suggested as the series of changes which have produced the carbonates of copper:

1. A period of wet weather during which the rocks and ore formations within surface influences become saturated with, and all cavities full of, water.

2. A period of dry weather. At first the excess of water drains off rapidly, leaving the rocks merely wet all through. As the drying proceeds, oxidation of the damp minerals goes on as fast and sulphates are formed. The flow of water is insufficient to carry these far, so they saturate part of the adjacent earthy minerals, and also effloresce in cavities, particularly where there is a current of air. Finally, at the end of the dry period, the sulphates will be left as such, forming quite dry mixtures with other substances, and incrustations or crystals in cavities and fissures.

3. Another wet period arrives. At first the descending water permeates slowly and is saturated with carbonic acid and soluble carbonates, the slow soaking of which over the dry sulphates converts the latter into carbonates. As the volume of water increases, the CO_2 and soluble carbonates become less, but the sulphates will have been already converted into carbonates, so they are not dissolved. Finally, the rocks become saturated with water, the wet period passes away, and another cycle of change commences.

Every cycle will add fresh layers of carbonate to the incrustations, and fresh crystals to the fibrous bundles in the cavities, until at last solid masses of concretionary and fibrous crystalline malachite result.—The Engineeering and Mining Journal.

TETANUS ANTITOXIN.‡

ONE by one the diseases which have hitherto defied the skill of physicians are yielding to the persistent attack of modern science. Since the successful treatment of diphtheria by subcutaneous injections of antitoxic serum was demonstrated—hardly three years ago—it has been confidently predicted that sooner or later all diseases which result from the action of a poison secreted in the blood by a special and characteristic bacillus would be conquered by similar means.

From the evidence now presented, it would appear that tetanus, one of the most sinister and stubborn of human maladies, if not already conquered, is in a fair way to be successfully overcome. In the Deutsche Medicinische Wochenschrift (Berlin) for October 23, appears a joint announcement by Prof. Dr. Von Behring, of diphtheria antitoxin fame, and Prof. Knorr, of Marburg, describing the qualities and best methods of using the new tetanus antitoxin, which is now prepared under government supervision as a commercial product by the Farbwerke at Hoechst on Main, and offered for use by medical practitioners under the same conditions as diphtheria antitoxin from the same source.

Tetanus, as is well known, is an exceedingly painful and hitherto usually fatal disease caused by blood poisoning, generally the result of a wound. It is believed by physicians to be caused by the introduction into the system of a minute organism which rises from the ground in certain localities, so that the prevalence of tetanus varies greatly even in different districts of the same country. At all events, the disease has its characteristic microbe, which has been recognized, isolated, described, and reproduced by artificial culture. The distinctive symptom of tetanus is a peristent spasm of the voluntary muscles, aggravated by light, noise, or other disturbing influence to which the patient may be subjected. These spasms may affect any muscular portion of the body, but when, as is often the case, the maxillary muscles are principally attacked, the resulting malady is known as lockjaw.

The tetanus antitoxin described by Prof. Behring and Dr. Knorr is similar in nature, action, and in the methods of its preparation to the antitoxin of diphtheria. It is prepared and put up for use in two forms, viz., as a dry powder, which is used for the treatment of developed cases of tetanus in men and animals, and as a liquid solution, which is employed for prophylactic purposes. Its strength or degree of efficiency is measured, like that of antidiphtheritic serum, by antitoxic units. The dry antitoxin is designated as a hundredfold normal antitoxin, that is 1 gramme of the preparation contains 100 units of antitoxic power; in other words, is sufficient to neutralize 100 grammes of the normal poison of tetanus. It is put up for commerce in vials containing 5 grammes each, and the contents of one such vial are theoretically sufficient for the cure of a developed case of tetanus. It is dissolved in 50 cubic centimeters of sterilized water at a temperature of 40 degrees C. and injected hypodermically at a single dose. In the treatment of horses, the injection is made into a vein, by which the full action of the antitoxin is accelerated by about twenty-four hours, and this method of injection may even be employed with human patients in very severe cases or where the treatment is commenced at a late and perilous stage of the disease. To insure favorable results, the injection should be made, if possible, within thirty-six hours after the presence of tetanus is definitely indicated. The liquid solution is protected from contamination by germs in the atmosphere by a small admixture of phenol. The dry preparation, on the other hand, requires no such antiseptic while in that form, but when dissolved in water it becomes subject to deterioration, which may be prevented by the addition of 1 per cent of chloroform.

The tetanus solution is of fivefold strength, that is, 1 gramme of the liquid contains five antitoxic units, and in this form it is put up in sealed 5 gramme vials. In presence of wounds which give reason to fear lockjaw or other form of tetanus, a small subcutaneous injection of the solution is made, the quantity used being proportionate to the condition of the patient and the time that has elapsed since the injury was received. In all cases, the wound should be antiseptically treated, so as to prevent as far as possible the further generation of poison in the blood.

Tetanus is a disease of seldom occurrence in this section of Germany, and opportunities to test the remedy in actual practice are comparatively rare. One such case has been recently treated at the Hospital of the Holy Spirit, in Frankfort, the record of which is officially and minutely given.

On the 19th of September last, a coppersmith (L. M.), twenty-five years of age and resident in Frankfort, experienced after exposure to thorough wetting severe pains and stiffness in the muscles of the neck and throat. Two days after the first symptoms appeared he came under treatment by a physician, who kept the patient in bed and administered chloral and salicylate of soda. The symptoms of tetanus continued to develop, and on the night of the 29th of September became so marked and violent that on the following day the patient was transferred to the hospital. A careful examination revealed a small cut or scratch under the right ear, then nearly healed, and so slight in outward appearance that it had passed almost unnoticed. At the time of admission to the hospital the patient was growing rapidly worse. The chin was twisted far to the left, the head drawn backward and immovable, and the muscles of the body, especially the back and abdomen, were hard and tensely drawn. The patient was isolated in a dark room and treated with subcutaneous injections of morphine, which gave no relief. The slightest noise or disturbance, such as the entrance of the physician or nurse into the darkened room, induced severe spasms, and the condition of the sufferer continued to grow steadily worse. At 4 o'clock in the afternoon of October 1 a prolonged spasm of intense severity left no further doubt of a fully developed case of tetanus, and half an hour later five grammes of the hundred unit antitoxin, dissolved in 50 grammes of water, were injected hypodermically at three places on the breast.

During the evening of the same day, a slight but definite improvement was observed, and this continued throughout the following day, the spasms being fewer and of shorter duration than before the antitoxin had been administered. This condition was maintained from the 3d to the 6th of October, when the acute symptoms gradually returned, and by 9 o'clock in the evening became so severe that a second dose of 4 grammes of normal antitoxin was administered as before, with the result that before the next morning the muscles began to relax, the spasms became lighter and less frequent, and from that time, improvement was so rapid and sustained that on the 23d of October, sixteen days after the second injection of antitoxin, the patient was convalescent, and, at his own request, was discharged from the hospital.

This, in the opinion of the physicians in charge, was a typical and conclusive case, in which life could not have been saved by any other treatment previously known, and in which the course of the disease might unquestionably have been arrested and greatly shortened had the antitoxin been used when the patient first came under medical treatment, instead of ten days later, when the case had become one of acute and fully developed tetanus.

It is, of course, too soon to estimate the exact prophylactic or therapeutic value of the new remedy. That can only be determined by a long series of observations in actual practice, which will be made as rapidly as the comparative rarity of the disease itself will permit. Thus far, the antitoxin has been used experimentally, both in this country and in France, with horses, cattle, guinea pigs, mice, etc., and from these tests, and the hospital case above described, the indications are that its use entails no injurious result. The antitoxin is prepared with extreme care, subjected to rigid inspection and control at the imperial testing laboratory at Steglitz, and with this guaranty is placed within reach of bacteriologists and medical practitioners in all countries.—Frank H. Mason, Consul-General, Frankfort.

[Continued from SUPPLEMENT, No. 1101, page 17606.]

ON THE ORIGIN AND HISTORY OF SOME DISEASE NAMES.*

By WILLIAM SYKES, M.D. Dunelm., F.S.A., a Correspondent of the New English Dictionary.

ALTHOUGH the history of the adoption of the French word "diphtheria" in English medical literature, as well as its origin and final alteration, are much better known than that in some of the above terms, yet, on account of certain verbal peculiarities which mark its adaptation into English form, it is worth recapitulating. In 1821 Brettoneau, of Tours, read a communication before the then Académie Royale de Médecine on croup and malignant angina, in which the following paragraph occurs: † "Let it be permitted me to designate this phlegmasia by the name of diphthérite, derived from διφθερα, pellis; exuvium, vestis coriacea." In the same paper the adjective diphthéritique also occurs frequently. This new designation for a certain form of croupous inflammation was imported into English medical literature to a somewhat limited extent and in the modified form "diphtheritis." It did not, however, become a part of our terminology and was nearly invariably followed by reference to its French introducers and to French observations. It was accompanied in these instances by its adjective, Englished into "diphtheritic."

In 1855 Brettoneau, in a fifth memoir,‡ altered his term diphthérite into diphthérie. Sir J. R. Cormack § asserts that he did this because he had discovered that the disease was not of an inflammatory character. Is it not equally probable that some one had drawn his attention to the fact that his original coinage was made on a mistaken model? It was framed after the example of such words as "iritis," "bronchitis," "laryngitis," etc., where, however, the completed word is composed of two elements, one indicating the region or part affected, e. g., "ir" from "iris" in "iritis," the other the mark of inflammation, "itis." In Brettoneau's term, however, the primary element of the word dealt with the pellicular result of the inflammation, not at all with the part inflamed. Analyzed on the model of the other words ending in itis, Brettaneau's coinage resolved itself simply into "the inflammation of a skin or pellicle" instead of into that which he desired to imply, viz., inflammation characterized by the production of a skin or pellicle.

At the same time that Brettoneau, from whatever motive, altered his new substantive from diphthérite into diphthérie he also amended the adjective diphthéritique into the form diphthérique. In 1857 a historical epidemic of the disease crossed the channel from France to England, bringing with it its eagerly adopted French title, diphthérie, in the slightly altered form, "diphtheria."

Sir J. R. Cormack ‖ states that "diphtheria was a word almost unknown in English medical literature till 1859, when the Sydenham Society published a volume of memoirs on the disease," but in this he is quite mistaken; the word made its appearance in the English medical journals as early as 1857, while those of 1858 actually abounded with it, as did the American professional papers for the same year. Its acceptance was widespread and immediate, and it at once became an established member of our language. Not so with the amended form of its adjective diphthérique, which a few purists vainly endeavored to naturalize as "diphtheric." But, with the capriciousness which characterizes popular word adoption, "diphtheric" never became general, and, while Brettoneau's original substantive "diphtheritis" was relegated to the limbo of disused words, its derived adjective, "diphtheritic," was universally adopted in this country, and we have the curious spectacle of a substantive "diphtheria" and a resulting adjective "diphtheritic," which could by no correct method of derivation have been formed from it in a legitimate manner.

During the last few months I have noted with some pleasure that a more correctly formed derivative adjective, "diphtherial," has come into vogue, which may, perhaps, in course of time perform that which the equally correct "diphtheric" could not do, viz., entirely displace the older and incorrect "diphtheritic."

Croup, the name of a disease which is by some thought to be really diphtheria, was transferred during the last century from the Lowland Scottish dialect into a permanent position in our medical nomenclature. In parts of Scotland "to croup" is a verb meaning to cry hoarsely, to croak as a raven, to make a hoarse crowing sound. It appears to be allied in derivation to the English provincial word "roup," applied to a disease of fowls. The verb was also applied to the sound caused in the disease, a use not yet quite obsolete; in some medical works and in many nurseries a child is still said "to croup" when emitting the brassy, harsh cough symptomatic of the complaint. Afterward, by extension, the term "croup" was doubtless transferred

* Mineralogy, p. 211.
† Dictionary of Chemistry, new edition.
‡ United States Consular Report for January.

* From London Lancet.
† New Sydenham Society's Memoirs on Diphtheria, 1859, p. 20.
‡ Op. cit., p. 173.
§ Quain's Dictionary of Medicine, 1883, p. 374, under Diphtheria.
‖ Loc. cit.

to the disease itself. It was first used in medical literature by Dr. P. Blair,* of Cupar, Angus, in 1718, who in describing a hitherto unnoticed malady gave it its local designation. It was not, however, until 1765, when Dr. F. T. Home,† another Scotchman, published his treatise on the malady, that it obtained a permanent place in our nosology as a specific disease under its provincial name.

Measles is an old English disease name which so-called classical nosologists have vainly attempted to replace by such synonyms as "morbilli" and "rubeola." Dr. Creighton‡ says that originally the term "measles" meant the leprous—first in the Latin form miselli and misselle (diminutive of miser); and that John of Gaddesden, by haphazard bracketing of the disease of measles and the tubercular nodules of leprosy under the common name of "messles," caused the word to be divorced from its original connection with leprosy and restricted to its common use. "It can," he concludes dogmatically, "hardly be doubted that we owe the English name 'measles' as the equivalent of morbilli to John of Gaddesden." In this, perhaps from taking too exclusively English a standpoint in his examination of the literature of the subject, Dr. Creighton is probably in error. Dr. Skeat,§ a remarkably accurate writer, declares, on the contrary, that the word "measles" is wholly unconnected with the Middle English mesel, a leper, which merely meant originally "a wretch," from the old French mesel, Latin misellus, the diminutive of miser, wretched. Measles is, he says, derived from the Dutch maseln (measles); the disease is also called in Holland masel-sucht, the measle sickness, so translated by an old English writer. The literal sense is "small spots." The original word occurs in the Middle High German mase, Old High German masa, a spot. Hirsch‖ also states that the English word "measles" corresponds to the German maal and masern, and the Sanskrit masura, spots. Doubtless it is to this meaning of spots, hence spotty, that we owe the term "measly pork," as applied to the meat of the pig when infested with scolices of tænia.

Of names deliberately invented by medical scholars of set purpose for the designation of diseases or their symptoms some have taken a permanent place in our language and literature, while many more have sunk back into a merited oblivion. Of the former class many were coined to describe diseases or conditions previously unknown, and passed into common acceptation with the recognition of the existence of the maladies they described. Probably "bronchitis" may be taken as an apt illustration of this class. The word was introduced into use by the English Dr. Badham, in 1810¶ and afterward by the German J. P. Frank in 1812.** The disease itself had been hitherto little recognized or investigated under its old name of "peripneumonia notha," so that the alteration in name not only signalized an improvement in both pathology and treatment, but also accompanied a description of disease which familiarized both practitioners and the people with an easily recognizable and striking affection, very common among the poor, and was thus adopted, once and for ever, in the folk speech of the country.

Other words of this successful class of deliberate scientific coinage have held their ground simply because they were invented to meet the requirements of the learned in regions which, lying beyond the ken or need of the vulgar, were the sole possession of science. The word "aphasia" is an example of this series, the pathological condition it represents being wholly, and the clinical condition nearly, outside the observation and analysis of laymen. Therefore the word was forged by scholars for scholars, after due discussion and alterations, which would have been impossible in the case of a word which was amenable to the disturbing process of public approbation or disapproval.

Trousseau†† tells us that "the affection now called 'aphasia' was in 1841 termed 'alalia' by Professor Lordat, and that in 1861 M. Broca changed this name for that of 'aphemia.' But M. Chrysaphis, a very distinguished Greek scholar, and himself a Greek, although accepting the term 'alalia,' proposed as a better one that of 'aphasia,' derived from α, privative, and φάσις, speech. M. Littre, whose authority is so great, and M. Briau likewise preferred the word 'aphasia,' and all three concur in rejecting 'aphemia.'" Trousseau himself had at first adopted the name of 'aphemia' after M. Broca, but afterward, on the authority of the scholars named above, substituted for it that of "aphasia." To complete the transaction the German, Kussmaul, has more lately annexed Professor Lordat's discarded word "alalia," and applied it to stammering, an entirely different disease.‡‡

One of the most successful and extensive artificial systems of nomenclature in a kindred branch of science was that of Dr. Barclay. In 1803, being then a teacher of anatomy in Edinburgh, he published a new system of anatomical nomenclature, which was so successful that a number of his suggested terms were at once adopted by anatomists and incorporated in their works. Many of them remain in daily use even now. He recommended about twenty-five new adjectives, or adjectives with new meanings, to denote the various aspects and situations of the organs and limbs, etc. His list includes such useful and common words as mesial, lateral, dextral, sinistral, peripheral, central, proximal, and distal.

Thus we see physicians and scholars forging new names as blacksmiths forge horseshoes, but it is, as noted above, only while these new creations are retained in the calmer atmosphere of science that they maintain their vitality. Once let these word smiths begin making new names for folk maladies, and their artificial creations immediately crumble to pieces before the more robust denizens of the land. It is doubtful, for instance, if Barclay's system of anatomical nomenclature would have so rapidly commended itself if applied to some more popular science. As it was, the moment Barclay transgressed the genius of our language his proposed alterations were ignored and are now forgotten. This was so in the case of his new system of adverbs, of which he suggested a like number with his adjectives. While the latter ended in "al," the former concluded with "ad," and we had "laterad," "dextrad," "sinistrad," and a score or so more of like monstrosities, a very few of which struggled on in very occasional use for about forty years,* and are now quite obsolete. Even when scientific coinages have been adopted into the language of the people it is not always certain that men of fair culture correctly analyze them into their original constituents and real signification. In a recent novel of an American author, Frank Stockton,† the following sentence occurs: "She was, in a certain sense, a floraphobist, and took an especial delight in finding in foreign countries blossoms which were the same or similar to the flowers she was familiar with in New England." Here the author has evidently formed his word "floraphobist" on some such imaginary model as hydrophobist, derived from hydrophobia, a well-known disease name handed down to us from Celsus. But unfortunately the result arrived at is entirely opposite in meaning to what the writer intended. "Floraphilist" was the thing the author desired to indicate, but, evidently confusing in his mind the madness of rabies with the last section of the word "hydrophobia," he took it as tantamount to "mania," and deemed that a "floraphobist" was the same as a "flora-maniac"—a somewhat unfortunate blunder, well illustrating the contention that mere scientific coinages, however ancient, hardly ever sink into the understandings of the people so completely as native terms do.

When, however, a disease name of scientific invention has once become welded into the language of the nation it almost invariably holds its own against subsequent attempts of scientists at emendation, just as a folk name does. Take typhoid fever, for instance. Originally introduced by Louis in 1829 in his classical memoir on the subject,‡ fievre typhoide has been in general French use ever since, and was widely adopted in England about 1851. From an imaginary possible confusion between the adjective "typhoid," as applied to certain conditions of an asthenic, non-specific nature, and the specific fever itself, Dr. Murchison was led to invent an improved name, "pythogenic"—that is, filth—fever. This was, on the obvious ground of incorrect suggestion, at once objected to, was never very widely accepted, and is now quite obsolete. Dr. Wilks, of Guy's Hospital, for the same theoretical reason, proposed "enterica" or "enteric fever" as a preferable term. This has had a more general acceptance unfortunately, especially among medical writers connected with Guy's Hospital, and is frequently to be found in medical reports and works. It has, however, never gained a footing in the literature or language of the people, and will, therefore, when it has produced its only effect, that of confusing the lay mind, finally die a natural death. Meanwhile, even those very purists who object to the term "typhoid" as likely to confuse, agree that "enteric fever" is probably caused by the bacillus typhosus of Eberth. The German "typhus" in connection with this disease is, in fact, to be retained, while the French "typhoid" is to be sternly rejected.

Beyond such historical interest as this paper may arouse, its aim is to draw attention to the principles on which disease names have been successfully formed in the past and to offer a few suggestions for their formation in the future: 1. Since medical literature in this country has become essentially English, disease names which are most in sympathy with the genius and structure of our language or are actually drawn from our speech are most suitable for adoption by us. Since the writing of our literature in Latin has for ever ceased, the attempted classicizing of names introduced from other sources ought to be abandoned. It has, for instance, been attempted to Latinize "dengue" into "denguis," an absurd endeavor. 2. A disease name once generally adopted should never on any pretense be changed. Such alteration only confuses the records of historical medicine. In many of the diseases described by older authors we vainly seek for their real nature under an unfamiliar nomenclature. On the other hand, imaginary disease names invented in modern days for historical epidemics are equally misleading. The "black death" which ravaged Europe during the years 1348–50 with such terrible results is not to be found in any contemporary literature under that name, which has been shown by Dr. Murray in the New English Dictionary to have had no more recondite a source than Mrs. Markham's "History of England," published no earlier than the beginning of the present century for the instruction of children. 3. It is vain to attempt to replace a folk name or one widely adopted by the people by a new one deliberately coined by scholars, and this for the following reasons: first, whatever names may be accepted by medical men must be translated by them into the vernacular of their patients, and by a resulting reaction the vernacular name comes to be the commoner one with themselves; and, secondly, there is no continuity or unchangeableness in the terms invented by savants, which are amended, improved upon, and displaced by the next writer on the subject, or, even more absurdly still, by the very inventors themselves in a subsequent publication. A striking instance of this occurs in that excellent work, "Fagge's Principles and Practice of Medicine." In the first edition, published in 1886, German measles is termed "rötheln," but in the second edition, issued only two years later, it is promoted to the dignity of "rubeola." Meanwhile, some writers call measles themselves "rubeola" and others "morbilli"—a pretty confusion, indeed, for the subsequent historian to unravel. These nosologists are, indeed, like one of Thackeray's characters, Lady Southdown, who having forced her followers to accept Podger's pills and Jowler's religion, had by the time their adherence was secured become herself a doubter and expected them instantly to abjure those heresies, medical and theological, and to accept other prophets equally extreme. 4. All language is the result of natural growth and cannot be artificially created. It is, therefore, more scientific to accept the products of natural development than to indulge in an artificial and therefore ephemeral system of cultivation. 5. All disease names are only labels by means of which the maladies themselves can be identified, discriminated, and classified, and those names are the best which are simple, distinctive, and express no theories of causation. It is the folk names which most often meet these requirements, and therefore deserve the widest adoption by us in the future.—London Lancet.

* Miscellaneous Observations in the Practice of Physic, etc. London, 1718.

† Inquiry into the Nature, Cause, and Cure in Croup. Edinburgh, 1765.

‡ Op. cit., vol. v, p. 632.

§ Concise Etymological Dictionary, fourth edition, 1894, p. 276, under Measles.

‖ Handbook of Geographical and Historical Pathology: New Sydenham Society's edition, vol. i, p. 154.

¶ On the Inflammatory Affections of the Mucous Membrane of the Bronchiæ, London, 1810.

** Interpretationes Clinicæ, i, 110.

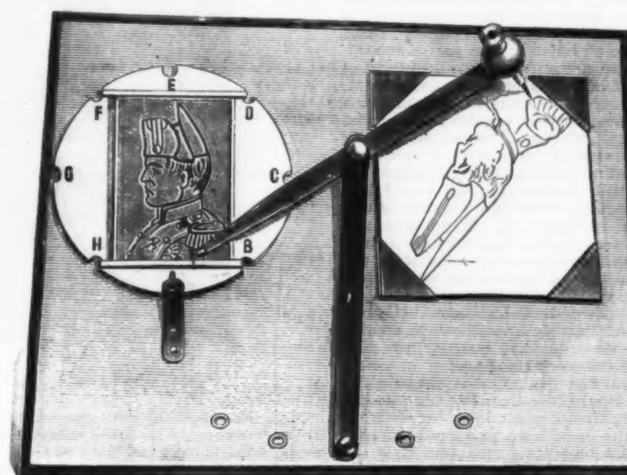
†† Lectures on Clinical Medicine; New Sydenham Society's Translations, vol. i, lecture vii, p. 218, note.

‡‡ Ziemssen's Cyclopedia of Medicine, English translation, vol. xiv, p. 693.

* A good resume of Barclay's nomenclature will be found in Wishart's translation of Scarpa's Treatise on Hernia, Edinburgh, 1814, p. xiii et seq. The latest anatomical work in which I have noted any instances of Barclay's adverbs is Todd's Cyclopedia of Anatomy and Physiology, 1849, etc. The question has been raised whence was the form ending in "ad" derived—in "centrad," for example. The New English Dictionary suggests it as derived from the Greek κεντραδε, but the words are entirely Latin in construction, and were, I doubt not, formed by the displacement of the Latin participle "ad" (to or toward) to the end of the new coined name.

† A Borrowed Mouth, and Other Stories, 1887: Our Story, p. 271.

‡ Recherches Anatomiques, Pathologiques, et Therapeutiques sur la Maladie, etc., Paris, 1829.



THE CARICATURE PANTOGRAPH.

THE CARICATURE PANTOGRAPH.

THE caricature pantograph permits of obtaining an infinite number of more or less grotesque transformations of any portrait or drawing whatever. It is a very simple instrument and is as easily manipulated by a child as by a grown person.

It consists of two strips of metal or wood forming a T, the horizontal part of which is capable of revolving around the upper part of the vertical piece. At one of the extremities of the horizontal piece there is fixed a pin with which the lines of the drawing to be transformed are followed, and, at the other, a pencil that draws the caricature that it is desired to make.

In order to make use of the instrument, the free extremity of the vertical piece is first fixed to the drawing board by means of a screw passing into one or another of the five apertures with which the board is provided. The drawing to be caricatured is afterward placed upon a disk of cardboard, and the different lines are followed with the pin of the horizontal arm piece.

It is possible to obtain five different transformations without touching the copy by jointing the extremity of the vertical piece at each of the apertures in the board in succession.

In order to still further increase the number of the caricatures, the disk upon which the drawing is to be transformed is rendered movable around an axis passing through its center. The circumference of this disk is divided into a certain number of equal sections, A, B, C, D, E, F, which may be arrested in succession at properly spaced register marks by means of notches, which also give the disk the necessary immobility.

Since to every displacement of the disk there corresponds a different position of the drawing, and consequently a new transformation, and since for the original copy there may be substituted one of the caricatures obtained, the number of the transformations possible is infinite.—Le Monde Illustré.

AN International Congress of Experimental and Therapeutic Hypnotism is to be held in Paris.

MANILA ROPE.

OF the many vegetable fibers which are suitable for the manufacture of rope—by which term is understood all varieties of cordage which are more than an inch in circumference—comparatively few are used, and of these by far the best is common hemp, which combines in a high degree the requisite qualities of flexibility, strength and endurance. At the head of the list in the possession of these qualities is manila hemp, the produce of the stalks of Musa textilis, a native of the Philippine Islands. Next in value to manila hemp is the sisal hemp, of South America, phormium hemp, of New Zealand, and the sunn hemp, of the East Indies, all of which are largely used in rope manufacture. A cheap rope, but of inferior strength and endurance, is also manufactured from jute, a vegetable fiber which was originally obtained from Bengal, India.

On account of its remarkable tensile strength, manila hemp is unapproached as a fiber for the manufacture of cordage, especially of the larger size, although it does not possess sufficient flexibility for twine and small cord.

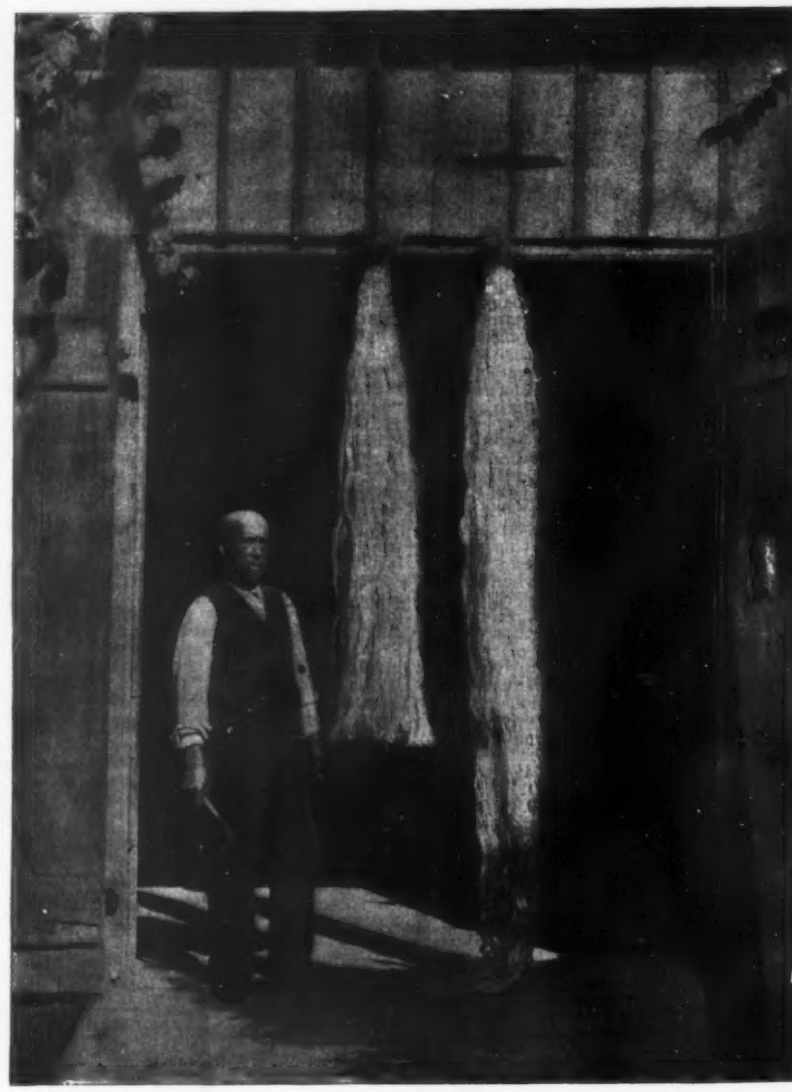
Until the introduction of modern machinery, the yarn was twisted by hand under a long, covered shed, called the "ropewalk." Two workmen were engaged in the operation, one of whom twisted the end of the yarn, in early times by hand and in later days by a hand wheel, while the other workman, with a large quantity of combed fiber about his loins, walked backward down a "ropewalk," pulling out the fiber into a thread as he proceeded.

Until the introduction of modern machinery, this had remained the method of manufacture for thousands of years.

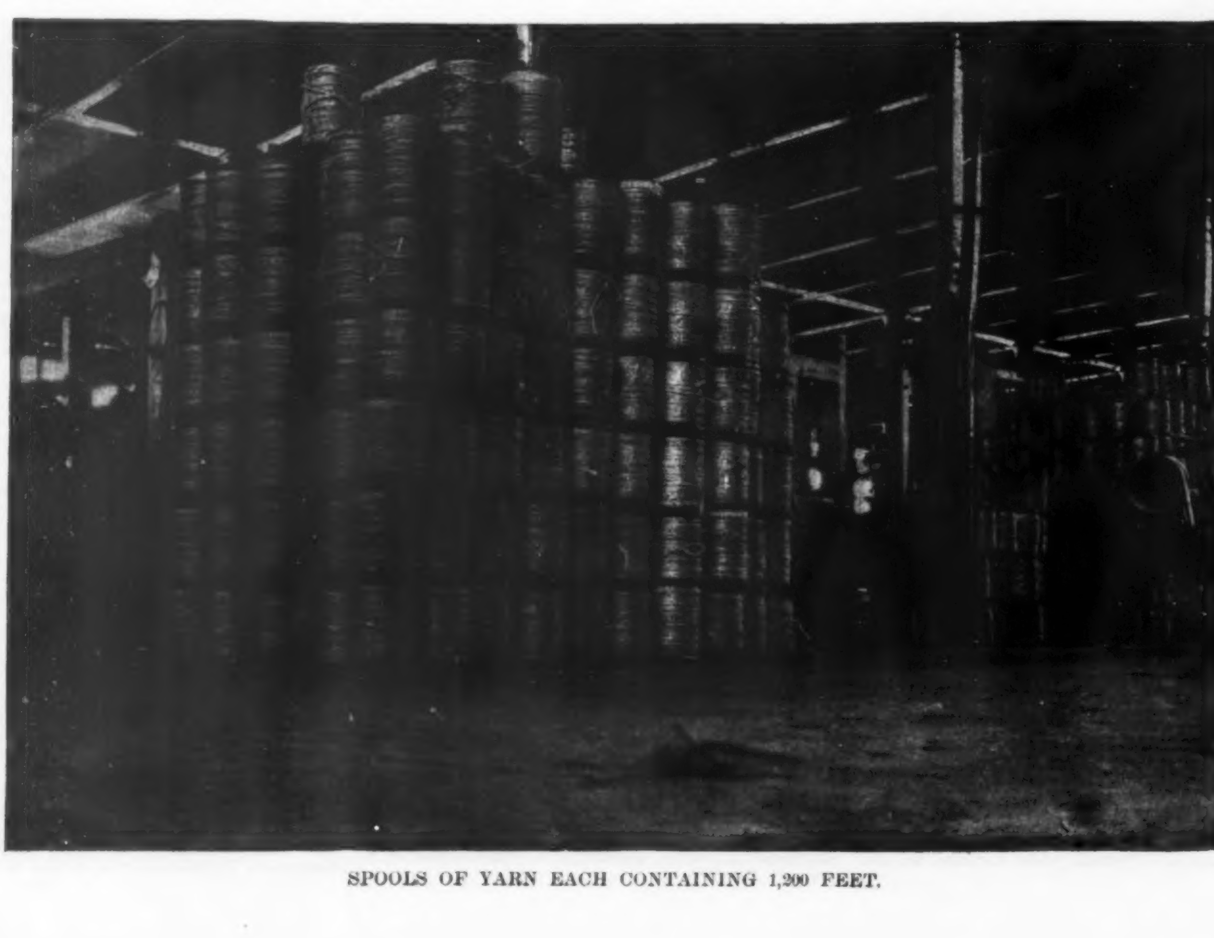
A sculpture found in a tomb at Thebes, of the time of Thotmes III, the Pharaoh of the Exodus, represents the process of making ropes from thongs of leather. The thongs are cut by turning the piece around as the workman cuts with a knife—the same means that we now use. Two coils of finished rope are shown. As the workman receded, he twisted the rope by some kind of a swivel that evidently had a weight, used both for a handle to twist the rope and, by its weight, to prevent the rope untwisting. An assistant arranged the strands as the work progressed.

In the modern manufacture of rope the stems are subdivided by machinery in order to obtain fiber of suitable size, and the fibers are then spun into a yarn, yarn being twisted in the direction called "right hand." From twenty to eighty of these yarns, according to the size of the rope, are put together and twisted in the opposite, or "left hand" direction, into a strand. Three of these strands, for a three strand, or four, for a four strand rope, are then twisted together, the twist being this time in the "right hand" direction. It will be seen that, when the strand is twisted, it untwists each of the threads, and when the three strands are twisted together into rope, it untwists the strand, but again twists up the thread. It is this opposite twist that keeps the rope in its proper form. When a weight is hung on the end of a rope, the tendency is for the rope to untwist and become longer. In untwisting the rope it would twist the thread up and the weight will revolve until the strain of the untwisting strand just equals the strain of the threads being twisted tighter. In making a rope, it is impossible to make these strains exactly balance each other, and it is this fact that makes it necessary to take out the "turns" in a new rope, that is to say, untwist it when it is put to work. The proper twist that should be put in the threads has been ascertained approximately by long experience. The greater the twist the more hard and rigid the rope is, and the better it will keep its form; but it is not quite as strong, because the fibers do not lie exactly in the direction of the center line of the rope, but at angle with it, and the greater the twist, the greater is the angle. The difference in this respect, however, among the different makers is slight in practice.

If we place the fibers of manila rope beneath a microscope, we find that they are composed of very much elongated cells, that look like a bundle of pipes. These are very strong in the direction of their length, but are weak transversely, as they are not strongly cemented together. To obtain fibers of suitable size for manufacturing rope, the stems are subdivided by machinery, by which means the cells are separated from each other, and the surface of each fiber is left rough and uneven, somewhat like the surface of pine wood when it is split open. In bending a rope over a sheave or pulley, the strands and the yarns of these strands slide a small distance upon each other, the surface roughness causing friction and internal wear of the rope. The extent of this wear is little understood, but if a worn-out rope be opened by untwisting the strand, the interior will contain a fine powder, showing that the strands, in sliding on each other,



MANILA FIBER.



SPOOLS OF YARN EACH CONTAINING 1,200 FEET.

have ground some of the fibers to pieces. To obviate this difficulty, the C. W. Hunt Company have resorted to lubrication, using plumbago mixed with a sufficient amount of tallow to hold it in position. This lodges in the hollows and uneven places of the fibers and lubricates the threads and yarns of the rope, and prevents this internal chafing and wear.

The tallow makes the rope partially waterproof, and, after running a short time, the exterior gets compressed and coated with the lubricant, so that when running it has a metallic luster. In this condition it resists ordinary rain to a surprising extent.

The amount of work that a rope will do depends not merely on the quality of the fiber and the method of laying up the rope, but also on the kind of weather where the rope is used, and the blocks or sheaves over which it is run. The principal wear, however, comes from the defective or badly set sheaves and from excessive load and exposure to storms. The table given below shows the horse power of "stevedore" rope (which is the name given by the Hunt Company to the lubricated rope above mentioned) at various speeds with an arc of contact not less than 170°:

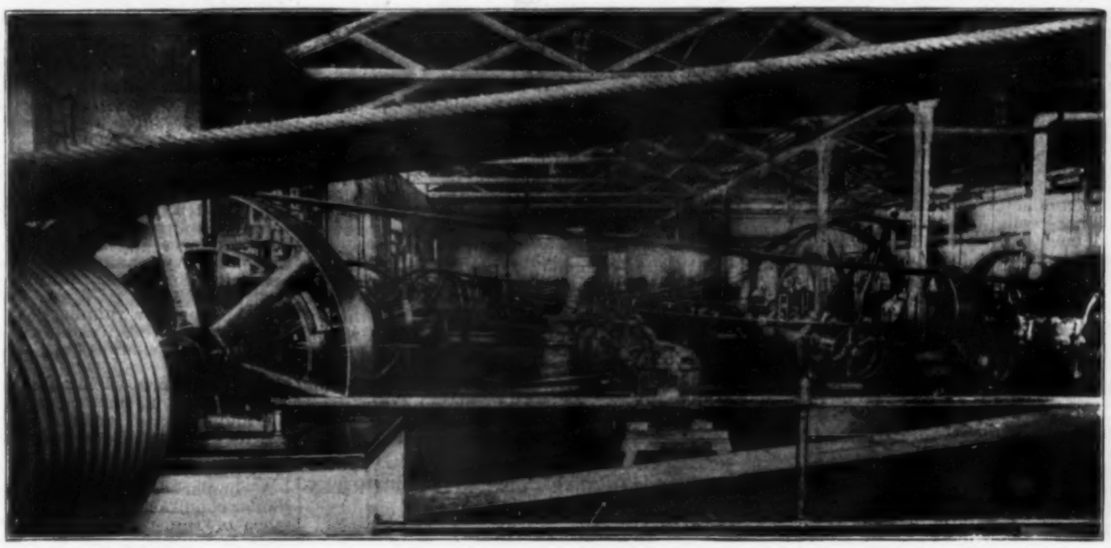
The indications of excessive load will be the twist coming out of the rope, or one of the strands slipping out of its proper place. After a certain amount of twist has come out of a new rope, the rope should remain substantially the same, and if it does not, it is safe to say that the load is too great for its durability. If the rope wears on the outside and is good on the inside, it shows it has been chafed in running over the pulleys or sheaves; if, on the other hand, the blocks are too small, internal wear of the kind mentioned above will take place.

The accompanying table, showing the horse power of driving ropes and the diameter of pulleys suitable thereto, is based on the assumption that a rope 1 inch in diameter should have a working strain of 200 pounds at all speeds. This is about one-twentieth of the strength at the splice, and this large margin is chosen to enable the rope to perform a large amount of useful work before renewal. Many engineers, however, recommend a much larger horse power than is given in this table, but the Hunt Company are satisfied, after long experience, that these lower estimates are advisable, except in temporary installations.

Diameter of ropes.	SPEED OF THE ROPE IN FEET PER MINUTE.											Smallest diameter of pulleys in inches.
	1·500	2·000	2·500	3·000	3·500	4·000	4·500	5·000	6·000	7·000	8·000	
½	1·45	1·9	2·3	2·7	3·0	3·2	3·4	3·4	3·1	2·2	0	20
⅝	2·3	3·2	3·6	4·2	4·6	5·0	5·3	5·3	4·9	3·4	0	25
¾	3·3	4·3	5·2	5·8	6·7	7·2	7·7	7·7	7·1	4·9	0	30
⅞	4·5	5·9	7·0	8·2	9·1	9·8	10·8	10·7	9·8	6·9	0	36
1	5·8	7·7	9·2	10·7	11·9	12·8	13·6	13·7	12·5	8·8	0	42
1¼	9·2	12·1	14·3	16·8	18·6	20·0	21·2	21·4	19·5	13·8	0	54
1½	13 1	17·4	20·7	23·1	26·8	28·8	30·6	30·8	28·2	19·8	0	60
1¾	18·0	23·7	28·2	32·8	36·4	39·2	41·5	41·8	37·4	27·6	0	72
2	23·1	30·8	36·8	42·8	47·6	51·2	54·4	54·8	50·0	35·2	0	84

The groove of the pulley in which a rope runs should be made with the greatest care both as to its diameter, its form and its workmanship. If the groove is too sharp, the rope wedges down and puts an unnecessary pressure and friction about it; while if the rope receives a swaying motion from the wind or any other cause, it chafes against the sides, causing an excessive wear of the rope.

An angle of 47° for the grooves has been found to give good satisfaction. This angle is equivalent to increasing the coefficient of friction of the rope on a flat faced pulley about 2½ times. The sides of the groove are straight and the bottom flat, the object being to have a groove which will have the same coefficient of friction when the rope is new and when it has worn smaller. The sides of the groove should be accurately turned and carefully polished, otherwise fibers of the rope rubbing on the surface of the metal, roughened as it is by the lathe tools, will injure the rope, breaking the fibers. Indeed, if the sides of the groove were polished as smoothly as the sides of the razor, the life of the rope would be indefinitely prolonged, as the wear of the rope is principally caused by rubbing on the grooves of the pulley and not by the internal chafing of the fibers, such as occurs with the ordinary manila ropes. Moreover, all sand or blow holes should be carefully avoided, as they will also cut the rope with great rapidity. It is scarcely necessary to state that the size of the pulley has an important effect on the wear of the rope. In a large sheave, the fibers slide less upon each other, and, consequently, there is less internal wear. In general it may be said that the pulleys should not be less than forty times the diameter of the rope for economical wear, and, indeed, they should be made as much larger as is conveniently practicable.



ROPE DRIVES AT THE ELECTRIC LIGHTING STATION, LOS ANGELES, CALIFORNIA, TRANSMITTING 500 HORSE POWER.

Secretary Carlisle has sent to Congress his estimates for the fiscal year ending June 30, 1898. The estimates foot up $421,718,970, against $418,091,073 estimated for 1896-97, and $432,431,605 appropriated for that year.

OPENED STOCK ARRANGED FOR SELECTION OF FIBER.

THE RAILWAYS OF THE WORLD.

THE Railway Age, in its issue of September 11, presents some figures giving the total railroad mileage of the entire world according to the latest estimates. These statistics not only emphasize the position of the United States as the possessor of the largest length of such lines of any country, but call attention to the enormous magnitude of such lines of communication to the globe at large. When, as the journal in question remarks, it is considered that hardly more than fifty years have elapsed since the construction of the first railroads, the fact that their total extent has grown to a little less than 450,000 miles is fairly astonishing. This constitutes a length of main lines sufficient to encircle the world nearly eighteen times. There are few exceptions among the nations in their possessing such means of communication and transportation, and those exceptions are mainly unimportant and backward countries, while many of the old world peoples have but lately commenced the work of construction, which will continue till all the habitable face of the globe is covered with a close network of steel roads. An example of this is afforded by China, which extraordinary country has at last been converted to the necessity of possessing such facilities of intercommunication. Indeed, it might be mentioned here that the present time has emphasized this change of policy on the part of China by the award to an American manufacturing establishment of the contract for supplying locomotives for the Tientsin and Pekin railway line now under construction.

The newspaper from which the figures referred to are quoted tabulates them by continental divisions and continents, as follows:

RAILWAY MILEAGE OF THE WORLD.

Countries.	*Miles.*
Europe—	
Germany-Prussia, 16,688; other German states, 11,558.	28,246
France	24,841
Russia and Finland	22,096
Great Britain and Ireland	20,903
Austria-Hungary	18,664
Italy	9,088
Spain	7,548
Sweden	5,738
Belgium	3,445
Switzerland	2,160
Netherlands	1,927
Roumania	1,604
Portugal	1,454
Denmark	1,409
European Turkey, Bulgaria and Roumelia	1,249
Norway	1,072
Greece	569
Servia	3[illegible]6
Islands—Malta, Jersey, Man	68
Total Europe	152,422
North America.	
United States	179,393
Canada and Newfoundland	16,134
Mexico	6,990
Central America	621
Total North America	203,138
South America—	
Argentine Republic	8,675
Brazil	7,496
Chili	1,967
Uruguay	1,119
Peru	1,036
Venezuela	634
Bolivia	621
U. S. of Colombia	281
Ecuador	186
British Guiana	22
Paraguay	157
Cuba	1,075
Dominica	71
Other islands	457
Total South America	23,799
Asia—	
British India	18,777
Japan	2,237
Russia	1,895
Dutch India	1,222
Asia Minor	1,100
Ceylon	271
Siam, Malay and Port India	227
Cochin China, Tonquin, etc	201
China	124
Persia	34
Total Asia	26,078
Africa	
Cape Colony	2,440
Algiers and Tunis	2,029
Egypt	1,259
Orange Free State	681
South African Republic	615
Natal	399
Congo, Senegal, Mozambique, etc	777
Total Africa	8,141
Australia—	
New Zealand	2,161
Victoria	3,071
New South Wales	2,610
South Australia	1,880
Queensland	2,378
Tasmania	474
Western Australia	1,149
Hawaii	71
Total Australia, etc	13,795
Recapitulation—	
Europe	152,423
America	226,937
Asia	26,078
Africa	8,141
Australia	13,795
Total	427,374

It will be seen from this that North America furnishes no less than 47½ per cent. of the total, and the United States alone about 42 per cent., while European countries altogether have some 35½ per cent. of the world's entire mileage of 427,000 miles of steam roads. Unitedly, therefore, Europe and North America take the lead with nearly 83 per cent. of the railroad mileage in existence, or a little short of seven-eighths thereof. In absolute length of lines the United States, with its 179,000 miles, is far in advance of any other single country—so far, indeed, as to render comparison impossible. Next in order comes the German empire with 28,246 miles, France being third with 24,841 miles, Russia fourth with 22,096 miles, the United Kingdom fifth with 20,903 miles. Austria-Hungary is sixth with 18,664 miles. The only other countries in which the aggregate mileage reaches double figures are two British possessions—India, where the railroad mileage is no less than 18,777 miles, and Canada, or rather British North America, with 16,134 miles. Among other countries whose progress in railroad construction, though recent, has been extensive, particular attention may be directed to the Argentine Republic, which owns the respectable total of 8,675 miles; Brazil, where the total is 7,496 miles; Japan, with its 2,237 miles, and Cape Colony, with 2,440. Indeed, if Natal's total and that of the two Dutch republics of Africa are combined, the South African group of states boast of an aggregate of over 4,000 miles. China, it will be observed, has only 124, though from present indications the Celestial Empire promises to become within the next decade the scene of an important railway development.

The proportion of railway mileage to territory and population differs widely and affords some noteworthy extremes which are exhibited in the ensuing tabulation, including a number of the leading railway countries:

	Miles of railway.	*Miles per 100 square miles.*	*Miles per 10,000 inhabit'ts.*
Belgium	3,445	29.1	5.4
Great Britain	20,903	16.6	5.3
Netherlands	1,907	13.5	3.8
Germany	28,249	13.6	5.5
Switzerland	2,160	13.1	7.2
France	24,841	11.5	6.4
Italy	9,088	7.8	2.9
United States	179,393	5.7	26.1
Canada	16,134	.4	31.8
Mexico	6,990	.7	6.0
British India	18,777	.9	.6
Argentine Republic	8,675	.7	19.1
Australia	13,795	.6	32.4

The British Islands and Continental Europe (exclusive of Russia, Austria-Hungary and Turkey) lead in respect to the density of railroads in relation to their areas. Belgium, as of old, is the best supplied in this respect, with twenty-nine miles of line to every 100 square miles of territory, and Great Britain comes next with 16·6 miles of road to the same area. On the other hand, Australia has the largest amount of road to every 10,000 inhabitants, the proportion in its case being 32·4 miles, while Canada is a good second with 31·8 miles to the like number. The United States comes third in this respect, boasting as it does of 26·1 miles to every 10,000 citizens, and the Argentine Republic is in this respect one of the best supplied countries of the world, with 19·1 miles per 10,000 people. British India, one of the most densely populated countries in existence, has, as already mentioned, 18,000 miles or more of lines, but, divided into its enormous number of inhabitants, there are but six-tenths of a mile to each 10,000.

[Continued from SUPPLEMENT, No. 1101, page 17598.]

COMPRESSED AIR FOR CITY AND SUBURBAN TRACTION.*

By HERMAN HAUPT.

WEIGHT OF RESERVOIRS.

THE weight of reservoirs is in proportion to the number of cubic feet of free air that they inclose, and that again is in proportion to the length of run, and is entirely independent both of diameter and pressure.

The truth of this position can be demonstrated rigidly, but a simple explanation will suffice to make it clear.

Suppose a reservoir of any diameter, say 1 foot, is under a pressure of 2,000 pounds per square inch, 1 foot in length of such reservoir will weigh a certain number of pounds.

Now, suppose the diameter should be reduced to one-half or 6 inches, the thickness of metal to resist the pressure would be one-half as great as formerly, and the circumference also one-half, consequently the weight per foot would be one-fourth, but to secure equal capacity the cylinder must be four times as long, and, therefore, the weight, with a given capacity, must be the same whatever the diameter.

Again, suppose the pressure should be reduced from 2,000 to 1,000 pounds per square inch, the weight to resist this pressure would be reduced one-half, but to contain the same quantity of free air the capacity must be doubled, and, consequently, the weight would be the same as before.

It follows, therefore, that whatever may be the diameter of the reservoir or the pressure per square inch, the weight of reservoir to inclose a given weight of air will be constant.

What, then, is the weight per cubic foot of interior capacity required to resist a pressure of 2,000 pounds per square inch, equivalent to 136 cubic feet of free air?

If 35,000 pounds be assumed as the elastic limit of the material, and one-half, or 17,500 pounds, as the maximum strain upon the metal per square inch from an interior pressure of 2,000 pounds, then it will be found that the weight per cubic foot of interior capacity will be 115 pounds. The weight of the last importation of the German reservoirs was 106 pounds per cubic foot of interior capacity.

As the 115 pounds per cubic foot under 2,000 pounds pressure contain 136 cubic feet of free air compressed into 1 foot, the required weight of reservoir will be 0·856 pound for each cubic foot of free air that may be inclosed.

If, in addition, it should be assumed that 400 cubic feet of free air should be provided to run an 8 ton motor one mile, with sufficient allowance for contingencies, the weight of reservoir per mile run would be 338 pounds. This weight, it must be understood, applies to the motor only, and is the equivalent of 42 pounds per ton of motor weight. Trail cars will require only about one-third as much per ton.

RESULTS OF TESTS.

Compressed air motors have long since passed the experimental stage. They have been running for two years at Rome, N. Y., and through the kindness of the officials of the New York Central Railroad, have been repeatedly allowed to run on the main track, where a speed has been attained of 30 miles per hour with wheels of only 26 inches diameter.

It should be obvious to every person of intelligence that a compressed air motor can be planned to fulfill any conditions or perform any service within the capacity of a steam locomotive. Speed requires large wheels, length of run large storage. High grades and heavy trains require large cylinders. The motor must be adapted to its work and fulfill the conditions of its service.

Tests have been made repeatedly by engineers and experts from all parts of the country, all of whom, without exception, have made favorable reports. One of these tests, made in the presence of the writer and of Captain Fiebeger, of the United States Engineers, February 18, 1895, gave the following results:

Starting with a pressure of 1,900 pounds in motor, and temperature of 291° in the water of the reheating tank, the first six runs of 4,800 feet were made on an average of 221¼ cubic feet of free air per mile.

The next six runs of 4,800 feet, temperature 252°, required an average of 339 cubic feet per mile.

The water in the tank was then reheated by attaching a steam hose, to 302°, when the next run was made on an average of 208¼ cubic feet per mile, from which the required quantity of air increased as the water became colder to 377 cubic feet per mile. After the tenth run, the water was again reheated and the quantity of air fell per mile to 247 cubic feet and then increased to the fifteenth and last run, when the temperature was 247° and the quantity of air per mile 521 cubic feet.

The average expenditure of air during the whole test was 308 cubic feet per mile. When the water was emptied from the tank and cold air used, the consumption was 661 cubic feet per mile on the same track.

The motor was calculated to run a maximum distance of 12 miles with one charge of air, but as the reservoir capacity was 35 cubic feet, under 136 atmospheres, the cubic contents of free air was 5,760 cubic feet, which, divided by 308, gives 18·7 miles as the possible run if all the air could have been used. Allowing 2·7 miles as a reserve, there would still have remained an effective run of 16 miles. There can be but little doubt that by an efficient system of reheating, whereby the temperature could be maintained at 300°, a greater efficiency could be secured.

It is unnecessary to give the results of other tests; they have been quite numerous, and by different experts, and confirm substantially the conclusion above stated.

The motors now running daily on the One Hundred and Twenty-fifth Street railway in New York make 17 miles with one charge of air. The reservoir capacity, 50 cubic feet.

Why is compressed air cheaper, both in installation and in operation, than any other system of traction for city and suburban service?

It requires less power at the power station for a given service, and this means less cost for engine plant and a perpetual saving in coal consumption.

A comparison with the trolley must be based on similar conditions, and as the recognized maximum distance of transmission of electrical power under 500 volts is 5 miles, a line of 5 miles, double track, with two-minute headway, will be assumed as a basis of comparison, average speed 10 miles per hour, and 30 motors on line.

Electrical motors are usually supplied with two 25 horse power motors, making 50 horse power each, but as the full power is required only in overcoming the maximum resistances, the power provided at the power station is usually calculated upon a basis of transmission of 25 horse power for each motor.

This transmission involves many losses, and only a comparatively small portion can be actually utilized at the rail.

In the Engineering News of October 17, 1895, page 256, is found the following estimate, the indicated power of the engine at the power house being taken at 100:

	Per Cent.		Per Cent.
Engine friction	8	Remains	92·0
Belting and shaft	10	"	82·5
Dynamos	8	"	76·2
Transformers at power station	7	"	70·9
Line to substation	12	"	62·4
Transformers at substation	7	"	51·8
Rotary converter	16	"	48·8
Railway circuit	10	"	43·8
Car motor	15	"	37·2

This estimate gives only 37·2 per cent. of the indicated power at the station as effective at the rail; but as other estimates claim a higher efficiency, it will be assumed as 50 per cent.

The thirty motors on the track will therefore require 1,500 horse power as the prime mover at power house.

Thirty air motors, with a run of 10 miles, will require 4,000 cubic feet of free air, or 2,000 cubic feet per minute, compressed to 2,000 pounds, and the horse power at the station will be 900, or 600 less than with electricity, and there is no loss in transmission.

COMPARATIVE COST OF MOTORS.

It is usually claimed that the cost of compressed air motors is considerably greater than the cost of electrical motors for equal service.

This is a mistake; the comparison must be made under like conditions. The compressed air motor carries its power with it. The electric motor takes it from the line. A fair and just comparison requires that the cost of plant to furnish power on the line should be included or omitted in both cases.

Omitting the reservoirs, estimates for the air motors have been brought below the electric motors, notwithstanding the low price of the latter, due to active competition; but allowing the cost to be the same in both systems, a comparison will be made between the reservoirs for thirty motors and the line construction required to furnish the electrical power for an equal number.

The thirty air motors will require 110,000 pounds of reservoir, costing about $15,000; per motor, $500.

The cost of line work for 5 miles of double track, with thirty motors, will be $26,000; per motor, $866.

POWER PLANT.

Another great saving is effected in the cost of power plant. It is usual in electrical estimates to allow $80 per horse power at the power station, exclusive of land and buildings for engines, boilers, shafting, belts, dynamos and other apparatus.

The cost of 1,500 horse power, at $80 per horse power, would be $120,000.

Compressed air requires no dynamos, belting or shafting. Steam from simple boilers is piped directly to the compressor, and it would be an excessive estimate to assume that the cost is one-half that of electricity, or $60,000.

SAVING IN TRACK.

The track for air motors requires no girder rails or electric binding or welding. A simple cross-tie track, as is used for ordinary locomotives, is sufficient. The reason for this is that the weight on the air motor is

* Published in the Journal of the Franklin Institute.

spring-supported, and on the electric motor a much heavier load is rigidly attached to the axle. From a table furnished to the writer by Franklin L. Pope, it appears that the effect of a blow of one ton from a wheel passing over an obstruction ⅛ inch in height, at a speed of 20 miles per hour, is twenty-seven times as great when the weight is rigidly attached as when it is relieved by springs.

The saving with compressed air increases with the magnitude of the plant. Without incumbering this paper with detailed estimates, it is proper to state that the writer prepared a close estimate of the relative cost of electricity and compressed air for a transmission of 5 miles from the power station on an elevated railroad, such as the Third Avenue Railroad, in New York, with trains running at one minute intervals. The estimate for electricity was submitted to a prominent electrical engineer and pronounced correct. The cost was more than double that of the compressed air installation. In fact, the return electrical current could not be transmitted in the ordinary way by rail, but would require some special arrangement. The attempt to reduce the cost of copper by increasing the voltage of transmission is attended with great increase of risk to life.

A system that may prove satisfactory on a small scale and with a limited volume of business may result in failure if extended beyond certain limits. President Vreeland, of the Metropolitan system, in New York, in an interview recently published in the Herald, pronounced the underground electric system in Lenox Avenue unsuited for a line with a heavy business. It required sometimes from two to four days to locate a defect, which, when found, could be remedied in ten minutes.

In selecting any system for adoption, the sensible course is always to get estimates in detail from competent and unbiased engineers, covering every point of installation and of operation, and then find responsible contractors to guarantee the work within the limits of the estimates.

COST OF OPERATION.

It has been shown that the cost of installation of a compressed air system is much less than that of the ordinary cheap trolley with wooden poles. If it can be shown also that the operation is more economical, then there can be no question as to its superiority in this particular over the cable, underground electric and other systems, all of which are much more expensive than the trolley.

The following is the latest revised estimate of an engineer long connected with electric companies and familiar with all details of operation, but at present engaged in the introduction of compressed air installations:

MOTIVE POWER PER CAR MILE (RUN 120 MILES PER DAY).

	Cents.
Anthracite coal for compressor plant	0·870
Anthracite coal for reheating	0·110
Water, boiler feed, etc	0·022
Oil, waste, etc	0·024
Removal of ashes, etc	0·014
Operating labor	0·615
Maintenance of power plant, etc	0·163
Maintenance of motors, etc	0·280
Interest and general expenses	1·760
	3·858

TRANSPORTATION.

	Cents.
Maintenance of cars, trucks, buildings	1·619
Motormen, conductors, etc	6·133
General expenses, interest, etc	1·155
	12·765
Electricity, similar items included, costs	16·268
Difference, 27 per cent	3·503

SOME INTERESTING FACTS.

By reheating the air required for the operation of a motor, the efficiency may be so much increased that more power may be utilized in the motor cylinders than was expended at the power station in the compression of the air.

This statement has often elicited a smile of incredulity, as it seems to be in violation of the law of the conservation of energy, but it is susceptible of a simple explanation.

Take the horse power at the compressor, say 1,400 horse power to compress 3,600 cubic feet of free air per minute to 2,000 pounds, the foot pounds in 10 hours would amount to 5,544,000,000.

The number of motors that this amount of air would supply is 120, assuming cylinders 6 × 14 inches; wheels, 26 inches in diameter; speed, 6 miles per hour; consumption of free air, 300 cubic feet per mile; pressure, 140 pounds per square inch, cut off at one-tenth stroke; mean pressure, 46·2 pounds per square inch. These conditions would give 6,802,272,000 foot pounds of work in the cylinder of the motors, or 22 per cent. more than the foot pounds of power expended at the compressor.

How can this be explained? Simply by the reheating of the air, which increases its volume, and by the steam which accompanies it and adds greatly to the effect.

But if air is reheated and steam used as an auxiliary to increase the effect, will not the expense of reheating fully offset any advantages thereby secured?

COST OF REHEATING.

From tests made in 1879, it was found that for 50 cubic feet of free air passed through the reheater, 1 pound of water, in the form of steam, was absorbed; 300 cubic feet of air would, therefore, absorb 6 pounds of water. Under a pressure of 140 pounds, the temperature would be 353°, or for effective pressure of 140 pounds, the absolute pressure would be 160 pounds and temperature 364°. The latent heat at this temperature is 858°.

The heat units required to raise 6 pounds water from 60° to 364°, including the latent heat, will be 1,162 × 6 = 6,972 units. To raise the temperature of 300 cubic feet of air 23 pounds, from 60° to 364°, specific heat of air being 0·24, will be 304 × 23 × 0·24 = 1,678 units.

The total units required for reheating for 1 mile will, therefore, be 6,972 + 1,678 = 8,650 units, which would be supplied by four-fifths of 1 pound of coal, at a cost of 1¼ mills.

This coincides very nearly with Mr. Hardie's experience, that the cost of reheating was about one-eighth the cost of compression.

EXPANSION IN REHEATING.

Fifty cubic feet of dry air carries over one pound water, which in steam, at atmospheric tension, gives 52 per cent.

Air at 60° F., heated to 364°, will expand in proportion of 461 + 60 to 461 + 364, or 521 to 825, which is 58 per cent. Total increase of volume, 110 per cent. Hence, 300 cubic feet will become 633 cubic feet. Without reheating the water on the trip, the Hardie motor, at Rome, consumed 331 cubic feet per mile, 110 per cent. of which would be 695 cubic feet. The actual consumption of dry air was 661 cubic feet.

INFLUENCE OF SPEED IN CONSUMPTION OF AIR.

A very general, but very erroneous impression appears to exist in regard to the increased consumption of air in traction motors, due to an increase of speed.

It is assumed that the consumption of air must be in proportion to the horse power, and as the space passed over in a given time must be doubled, the horse power, in which space is a factor, must be doubled, and the consumption of air doubled also.

This is true, but the consumption of air per mile is not doubled by doubling the speed. The consumption of air is in proportion to the resistances to be overcome, and within reasonable and ordinary limits these resistances are but slightly increased by increase of speed. It is an error, also, to suppose, as many do, that in trolley motors an electrical attraction between the wheel and rail increases adhesion.

In support of these positions, authorities will be quoted. Oscar T. Crosby, in Transactions of American Institute of Electrical Engineers for August and September, 1894, states: "The adhesive coefficiency between the wheel and the rail is not increased in any practical degree by the passage of the current. In other words, there is no electrical attraction, as some suppose, between the wheel and the rail to increase adhesion. The adhesion is due to the weight on drivers alone."

The train resistances at high speeds do not increase, as is usually supposed, as the square of the velocity. At 86 miles per hour the total resistance per ton was only 13·4 pounds; 347 tons were carried at 86 miles per hour on a line by an expenditure of 1,068 horse power.

The resistance of the air is a function of the first instead of the second power of the velocity.

From 40 to 80 miles per hour, the tonnage coefficient is practically 8 pounds per ton on first class roads and best rolling stock.

Wellington, in his popular work on engineering, pages 922–924, makes statements as follows:

"Journal friction is variable, and is usually taken at 8 pounds per ton.

"The load per square inch on journal bearing has very little influence upon the friction.

"The velocity of the lowest journal friction is from 10 to 15 miles per hour.

"With good lubrication there is very little increase of journal friction up to 55 miles per hour.

"The coefficiency of journal friction is approximately constant at velocities from 15 to 50 miles per hour.

"The power required to overcome inertia and accelerate trains is about three times as much as to maintain velocity.

"The additional power required to get up speed is 45 pounds per ton to give 15 miles per hour in 3,340 feet.

"The air resistance at 10 miles per hour is less than ½ pound per square foot.

"The principal resistance, except axle resistance, is due to oscillation and concussion, which, at 10 miles per hour, may be taken at ½ pound per ton."

The above quotations from standard authorities do not sustain the statement of the expert of the General Electric Company, who stated in a criticism upon an estimate of the writer that "a calculation, which is not necessary to enter into, will show that to make an approximation to the average speed of 20 miles per hour, 600 horse power will be found not sufficient to do the work. Where the speed of an electric train is reduced to that assumed for the steam train (10 miles per hour), 300 horse power will be found abundantly sufficient."

The inference would appear to be that, if the speed of an electric train is increased from 10 to 20 miles per hour, the power must be increased from 300 to 600 horse power. If this be true, it is very bad for electricity, for it is not true in regard to either steam or compressed air. The power required must always be sufficient to overcome resistance, and if, as appears from the authorities quoted, the resistances are but slightly increased by increase of velocity, there cannot be any great increase of power required per mile of distance traversed as measured by consumption of air or steam. There must be some, of course, but in ordinary service it does not figure very largely in the expenses.

As practical tests are more satisfactory than theory, the writer requested Mr. Hardie to make a test of the consumption of air at different speeds, and report the result. The following is the report, under date of April 22, 1896:

FIRST TEST.—LOAD, 19,150 POUNDS.

Speed.		Cubic Feet per Mile.
3·00	miles per hour, consumption of air	347
5·70	" " " " "	334
6·81	" " " " "	488
7·57	" " " " "	335
7·80	" " " " "	568
8·50	" " " " "	452
9·70	" " " " "	388
10·10	" " " " "	560
10·30	" " " " "	275
11·40	" " " " "	604
12·30	" " " " "	421
13·00	" " " " "	538
13·70	" " " " "	447
16·70	" " " " "	450
17·05	" " " " "	447
22·80	" " " " "	445

SECOND TEST.—LOAD, 24,990 POUNDS.

12·27	miles per hour, consumption of air	334
15·34	" " " " "	449

THIRD TEST.—LOAD, 26,100 POUNDS.

6·70	miles per hour, consumption of air	437
8·00	" " " " "	452
10·34	" " " " "	479

FOURTH TEST.—LOAD, 36,000 POUNDS.

5·25	miles per hour, consumption of air	632
7·50	" " " " "	582
8·56	" " " " "	589
15·34	" " " " "	334

The above results are very remarkable. The ordinary pressure gages are not very sensitive, but it is impossible from the above table to infer that there was any increased consumption of air per mile, either with a largely increased speed or a considerable increase of weight. When a train is in motion, the drawbar pull is but slightly increased by a moderate increase of speed. The great losses of power are in acceleration and retardation in starting and stopping.

It has been stated that the power required on a good track to start a street car is 116 pounds per ton, and to maintain it in motion 13 to 17 pounds. On a bad track, 134 pounds to start and 35 pounds to maintain.

Mr. Hardie has found by tests upon his motor that 130 successive applications of the brake consumed, by gage pressure, 85 cubic feet of free air, equivalent to 0·65 cubic foot for each application.

Franklin L. Pope is authority for the following statement:

"A 16 foot trolley car, weighing about 14,000 pounds, requires eighteen seconds to get up speed and 10 horse power to run 10 miles per hour, or 1 horse power per mile per hour at car axle. Three times this power is required during the eighteen seconds of starting."

Frank S. Sprague, in New York Evening Post of February 8, 1896, states that on the Third Avenue Elevated Railroad the maximum effort in the propulsion of trains is seven times the mean traction on a level; and that to start a train, accelerate to 20 miles per hour and bring it again to rest, consumes eighty seconds.

David L. Barnes estimates that an elevated train of 130 tons can be accelerated to 30 miles per hour in a distance of 1,250 feet, and brought to rest in half that distance.

OTHER USES FOR COMPRESSED AIR.

Compressed air affords the most economical means for the transmission of power to long distances. It has been claimed that electrical power generated from waterfalls could be transmitted hundreds of miles, but the writer has attempted to show in a monograph that is too voluminous to quote that, in the present condition of the science, power by electricity cannot be economically transmitted in competition with power furnished locally by coal to a greater distance than about 20 miles. Long electrical transmission requires excessively high voltages, which are almost impossible of permanent and successful insulation, and instantly destructive to life in case of accidental contact. The late lamented Franklin Leonard Pope, in a letter to the writer, used this language: "A voltage of 20,000 may be possible in the future, but it has not yet been successfully accomplished. The difficulties seem to increase roughly as the square of the voltage; 10,000 volts is a wicked acting current, and when you double it, you had better watch out." He also adds: "The same speculative boomers who have put in 300 non-paying electric railroads throughout the country are now at work fostering a craze on electric power transmission. I am sorry to see it, for it will end in discrediting all legitimate electric work. The mass of people will never learn to discriminate between the practicable and impracticable."

The transmission of compressed air requires high pressures, for the reason that increased pressure gives increased density and reduced volume and velocity. The loss in transmission being as the first power of the density and the square of the velocity, the loss in transmitting under 200 pounds would be ten times as great as under 2,000 pounds. High pressures are necessary for economical transmission both with electricity and air.

But compressed air and electricity are not properly to be considered antagonists; they may be made valuable auxiliaries.

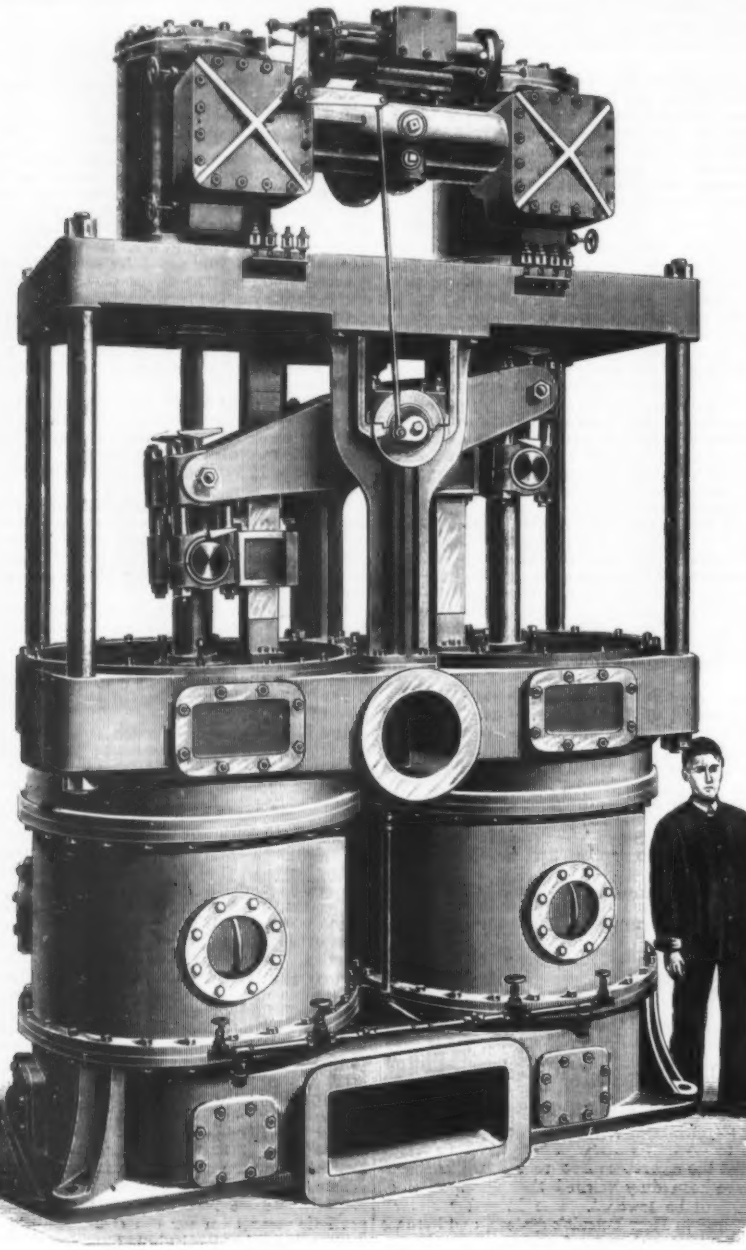
A 6 inch pipe under an initial pressure of 2,000 pounds per square inch, and a terminal pressure of 10 atmospheres, or 147 pounds, will transmit nearly 8,000 horse power to a distance of 10 miles, 5,700 horse power to 20 miles, and 2,500 horse power to a distance of 100 miles. Where there are mountain streams furnishing small powers at frequent intervals, a number can be concentrated in one pipe, and transmitted to furnish large power in distant localities. Compressed air, thus economically transmitted, can be used to generate electricity for local purposes. It can also be distributed to provide small powers, and also for ventilation and refrigeration in towns and cities.

The cable and electric systems, it is well known, are operated to best advantage economically at full capacity, but this is only for a few hours in the day. If surplus power were used to store air at high pressure in reservoirs, the machinery could be shut down entirely or partially, and compressed air motors substituted at night and during the hours when full capacity is not required.

ELASTICITY OF THE SYSTEM.

An important advantage of compressed air motors is found in the fact that each motor is independent, and unaffected by any derangement of feed or trolley wires, cables or dynamos. They can run on any line, in connection with any other system, and at any rate of speed. The introduction of air motors can be gradual; one motor can be tried, and, if satisfactory, the number can be increased to a full equipment. The steam required for electric or cable lines can furnish the little that is required for an experimental compressor, and will be more than sufficient for a full equipment. No outside expenditure whatever is required—no conduits, poles or wires. In this respect it differs from other

systems, and permits a test to be made at a minimum of cost; but compressed air motors can no longer be considered as experiments. While they may not have attained the utmost limit of perfection of which they are capable, the experience in Europe, in Rome, N. Y., and in the city of New York should be sufficient to satisfy the most skeptical.



AIR PUMPS BUILT BY AN AMERICAN FIRM FOR THE NEW ATLANTIC STEAMER KAISER WILHELM DER GROSSE.

ABBOTT'S BOAT RAISING AND LOWERING DAVIT.

The accompanying engravings illustrate a new boat raising and lowering davit, invented by Lieutenant A. W. Abbott, Royal Navy, and possessing several features of interest and novelty. The ordinary form of davit is replaced by davits pivoted on an upper frame, and partly surrounding the boat which is placed within their embrace. The davits themselves are pivoted upon a light, strong superstructure, and when inboard provide the means of holding the boat in one direction, while it is held in the chocks by grips or lashings, which are automatically released when the first operation toward releasing a boat is made. The davits are connected up in the line of their pivots by means of a spindle, upon which the davits rotate, and upon which they have a crane neck movement normal to the side of the ship. For working these davits a rope is rove through the block at the top of the bent davit levers, and through blocks fitted on the deck, and then through a block on a ring bolt or shackle on the structure toward the center of the ship. To get the boat into position another tackle is used, one block of which hooks on to a lug or ring fitted to the end of the lever or davit. The first mentioned rope tackle takes the weight of the boat after the boat's keel has passed outboard of the pivot. One of the details of the above engravings shows an end view of the self-relieving chock, which comes into action by the first movement of the lifting tackle, but which with the grips firmly holds the boat in place until the tackle is brought into use. The arrangement of this apparatus is, it will be easily seen, such that the boat is out of the way in any case, and firmly stowed, while the operation of putting it outboard by hauling upon the lower and pendent arm of the davits is very simple, as compared with that of swiveling separately the pair of ordinary vertically pivoted davits. The boat is, moreover, carried clear of the sides of the ship in almost any state of the weather, and it may be fully loaded before the lowering operation takes place. We are indebted to the London Engineer for the engravings and particulars.

AIR PUMPS FOR THE STEAMSHIP KAISER WILHELM DER GROSSE.

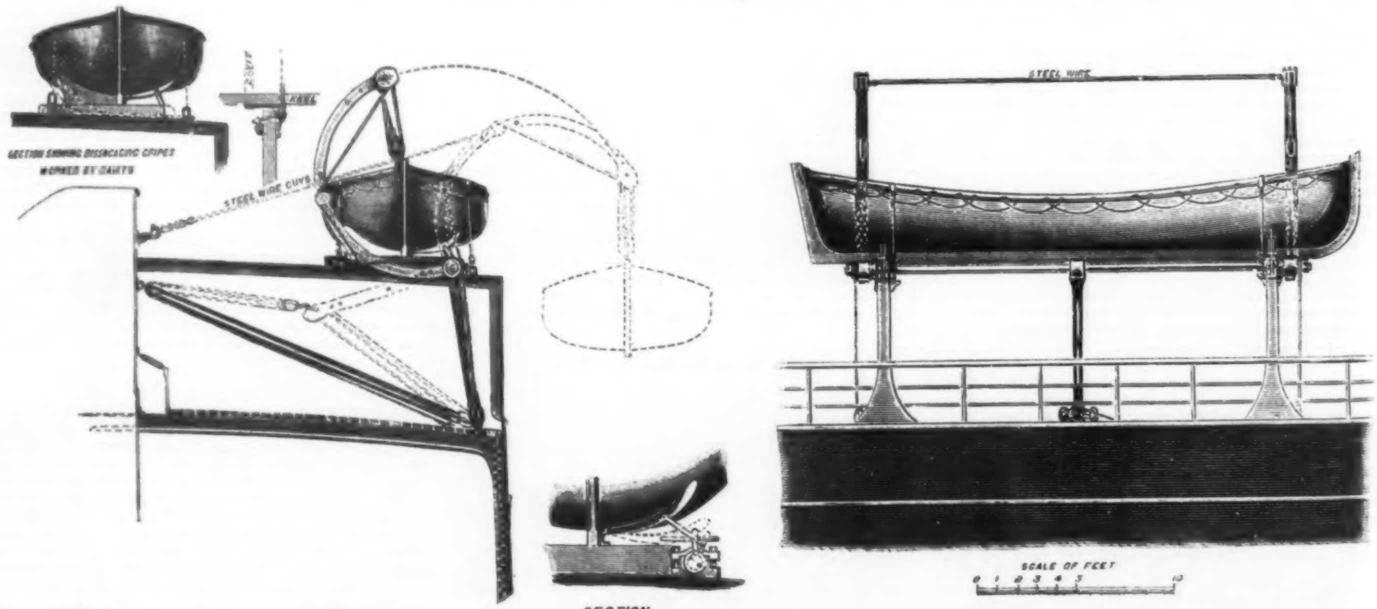
It is gratifying to note that an American firm has been intrusted with the work of building the air pumps for the great German steamer Kaiser Wilhelm der Grosse. They are of the Blake type and were manufactured by the George F. Blake Manufacturing Company, of New York. The accompanying illustration, for which we are indebted to London Engineering, shows their general construction, and it will be seen that they are of the independent variety, which is becoming so common in American practice, as distinguished from the attached pumps, working from the main engines, which are favored by the English builders.

The engines of the Kaiser Wilhelm, which vessel is being constructed at the Vulcan Works at Stettin, have cylinders 52 in., 90 in., and two of 97 in. diameter, the stroke being 69 in. The boiler pressure will be 185 lb. and the revolutions 77 per minute. The vessel is twin screw, and there will be one pair of pumping engines, as illustrated, for each set of engines. These air pumps are of the same type as have been fitted in the United States war vessels Minneapolis and Brooklyn, but slides and guides have been added on account of the large size of these pumps. There are two double acting steam cylinders 18 in. in diameter and two single acting air cylinders 44 in. in diameter, the stroke being 24 in. "At a test of these pumps, made at the Blake Company's works, East Cambridge, Mass., they formed a vacuum of 28·75, the temperature of the vapor and condensed water being about 80°. The pump was run as high as 75 double strokes per minute, and ran as smoothly and quietly as at one double stroke per minute. Although the pump was only placed on and not bolted to the floor, it worked without any vibration, showing that it is self-contained and the parts well balanced."

In the triple screw cruiser Minneapolis, the official trial of which took place on July 14, 1894, when a speed of 23·073 knots was reached, Blake pumps, similar in type to those illustrated, were fitted. In a descriptive article on this vessel by Passed Assistant Engineer Albert B. Willits, United States Navy, it is stated that there are three main air pumps (one to each set of engines) of the twin vertical type, similar to those fitted in the sister ship Columbia, whose dimensions are as follows:

Diameter of steam cylinders	16	in.
" pump "	31½	"
Stroke	21	"
Diameter of piston rod	3	"
" pump "	5	"
Number of foot valves, each pump cylinder	19	
Number of bucket valves, each pump cylinder	15	
Number of delivery valves, each pump cylinder	18	
Area of opening each valve seat	13	sq. in.
Ratio of volume swept by low pressure piston, per stroke, to that of two air pump buckets per stroke	8·6 to 1	

These figures apply both to the pumps of the Colum-



LIEUT. ABBOTT'S BOAT LOWERING APPARATUS.

bia and the Minneapolis. The combined cooling surface in the three main condensers of each of these vessels is 28,422 sq. ft.

In describing the trial of the latter vessel Mr. Willits says: "The operation of the main air pumps simply emphasized the justice of the claim of this class of pump for highest honors. Not only did they do remarkably efficient duty at the smallest cost in power, but the regularity and certainty of their action and their low speeds conduced to other efficiencies by reducing to a minimum all anxiety on the part of those in charge of the running of the machinery regarding their possible stoppage or breakdown, and of sudden and excessive change of speed. . . . Here at about only 15 double strokes per minute these pumps maintained a steady vacuum of over 25 in. at a cost of but little more than 30 horse power for all three double pumps, and with the main engines aggregating over 20,000 horse power. This power of air pump is only about one-sixth of one per cent. of the horse power of the main engines."

Speaking of the method of working, Mr. Willits says: "The operation of this pump differs from that of the 'duplex,' where one pump engine drives the steam valves of its neighbor, as here the engine which drives the main steam valves has no other function to perform, and is adjustable to its work. The arrangement may be briefly described as follows: The beam which positively connects the main piston rods of the pumps operates (from a point near its center and by means of rod and bell crank) the slide valve of the horizontal cylinder which lies between the main cylinders. The piston of this horizontal cylinder is really the driving engine of the main cylinder steam valves, a function which it performs by means of a system of internal levers. All the ports are of fair size, and the operation of the pump is not only as positive as the 'duplex,' but is decidedly more regular and complete. The adjustable collars on the valve stem of the valve driving engine afford a means for regulating for a full stroke at any speed, while suitable cushion valves give a further control over the action during the stroke, in regulating distribution of work and preventing slamming of foot valves." On trial the three sets of air pumps required respectively 8·39, 10·91 and 13·87 indicated horse power to drive them, according to cards taken from the steam cylinders. It may be interesting to further state, although not bearing directly on the present subject, that the three sets of main circulating pumps required respectively 18·44, 18·00 and 17·56 indicated horse power; the four main boiler feed pumps, 90·96 indicated horse power; 16 forced draught blowers, 263·04 indicated horse power; and other auxiliaries, 54·90 indicated horse power. The indicated horse power of the main engines only was 20,366, and of all machinery in use on the trial, 20,862 indicated horse power. This was on the full power trial.

The Blake company are to be congratulated that the excellence of their type of pump should have led the German builders to come so far for their pumping equipment, especially when it is remembered that the numerous marine engineering firms of Great Britain lie so much closer to hand.

THE REPAIR OF SINGLE TUBE BICYCLE TIRES.

SINGLE tube bicycle tires have become deservedly popular among American riders. Although it is sometimes more difficult to effect in them a positive and permanent repair than in the inner tube tire, a temporary repair good for a thousand miles or more of riding may often be made in a few minutes. We illustrate several methods of repairing such tires, which methods are divisible into three classes, plug repairing, patch repairing and band repairing.

Our first cut illustrates typical forms of plugs, one with a cylindrical stem, two double headers shaped somewhat like cuff buttons and another with a conical stem. They are made of various sizes and proportions.

One of the simplest and most popular means of inserting a plug is shown in the cut No. 2, where pliers specially made for the purpose are employed. The approved method of operating is to tie a string or strong thread tightly around the stem of the plug, which plug is then grasped by the pliers in the manner shown, is well lubricated with solution and is forced into the aperture with the head innermost; the solution is then squeezed out of the flexible tube, which is supplied with a special nozzle for the purpose, through the puncture, so as to fall upon the head of the plug within the tire. The tube of solution is withdrawn, the plug is drawn into place by the thread and part of the protuberance is cut off. The double header plug, such as shown in Fig. 3 of cut No. 1, is inserted by this instrument with the small head innermost. The large head is cemented to the outside of the tire by covering its inner surface and part of the tire adjacent to the puncture with rubber solution, allowing the surfaces to dry as perfectly as possible out of contact with each other, and by then pressing them together, when they instantly adhere.

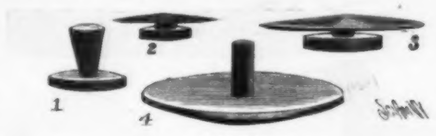
Cut No. 3 shows a method of introducing a plug by a very simple apparatus. Fig. 1 is a metal tube with cross handle. The tube is cut off obliquely at its lower end. With it is provided a bent piece of metal, Fig. 2, by means of which a plug previously moistened with a solution as a lubricant only, Fig. 4, is forced into its oblique end, Figs. 1 and 2. The tubular tool is then driven into the puncture and the pricker is forced down through it after its introduction, Fig. 3, so as to expel from it the head of the plug. On withdrawal of the two tools the plug is left in the aperture, and its head may be pulled up by means of its projecting stem against the interior of the tire. Fig. 5 shows the plug, and in the section of the tube one plug is shown in position.

In the next cut, No. 4, a more complicated apparatus is shown, used for introducing the plug shown in Fig. 6 of such cut. A pair of pliers of peculiar construction are arranged to support a cylindrical cutting edge, Figs. 1 and 2, of varying size. For each cutter a conical bed piece is provided, also shown in Figs. 1 and 2. The bed piece is secured to the pliers below its cutter, and the bed piece, which, as held by the pliers when open, will be in advance of the cutting edge, is forced through the puncture. By closing the pliers, the bed piece is drawn up against the cutting edge, so that a small round disk is cut out of the rubber. The cutting operation, as shown in Figs. 3 and 5, shows the result. By reversing the pliers and opening them, the plug is held in the other jaws, as shown in Fig. 4, and after a thorough lubrication with the solution is forced through the aperture into place.

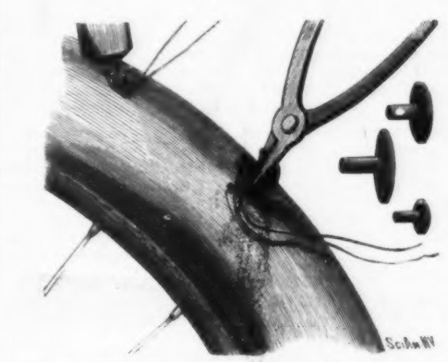
A peculiar system of introducing the plugs is shown in No. 5, where a plug with a hole in the stem is used. A piece of wire is heated, Fig. 1, in the flame of a match, and while hot is forced through the puncture, burning off the ends of the threads and leaving it ready for plugging, Fig. 2. The wire still hot, or slightly reheated if necessary, is now inserted in one of the apertures of the plugs, 4, to which it adheres. The plug, after lubrication, is forced into the puncture by the wire, which is then drawn back, pulling the head of the plug up against the interior of the tube.

We here encounter for the first time the burning out of the hole with hot wire, and for all phases of tire mending where a plug is to be used it is an excellent plan to burn out the hole rather than to cut it out by any means. The burning out removes the projecting ends of the threads and does away with the fertile source of so-called porousness.

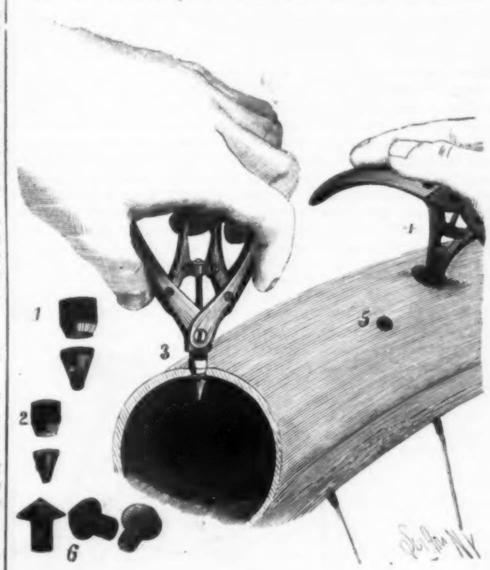
Band plugging is shown in the next cut, No. 6. A needle about eight inches long, with an end not too sharply pointed and containing a large perforation, is used. The other end should be bent into a ring shaped handle. The needle is threaded with one or more bands of India rubber. It is shown as used with a single band. If it be desired to introduce a single thickness into the puncture, on account of its smallness of size, the manipulation shown in Fig. 1 is adopted. The needle is threaded, a small portion of the band projecting from the eye; after lubrication with solution, the needle is introduced, and being directed very obliquely is pushed far in, the band being held back on the outside until it snaps out of the eye of the needle. On withdrawing the needle, a single thickness of the band is left in the puncture. If two thicknesses are required, the needle is thrust well into the tire through the puncture and withdrawn, as shown in Fig. 2, carrying with it the end of the band. In executing the manipulation of Fig. 2, the condition shown in Fig. 3 is always reached; when, if the ends are long enough, the bands may be cut at the bend where it passes through the



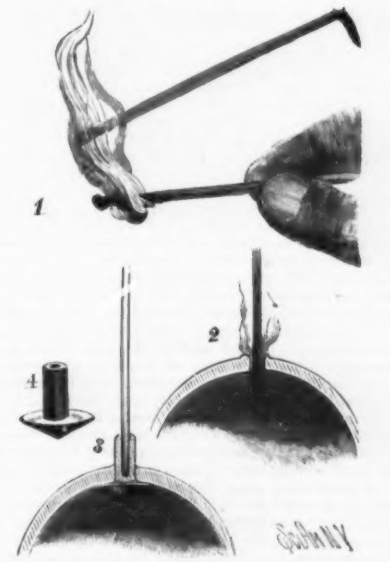
No. 1.


No. 2.—INSERTING PATCH WITH PLIERS.

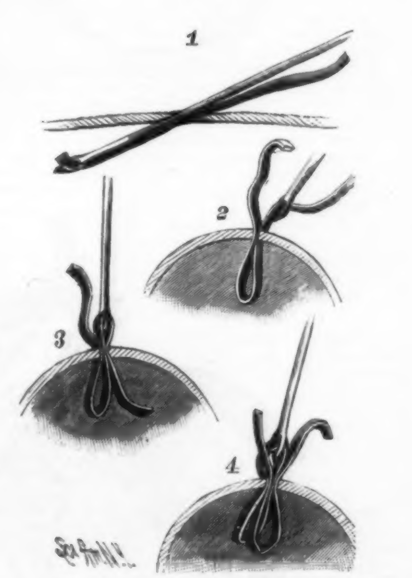
No. 3.—TIRE PLUGGER.



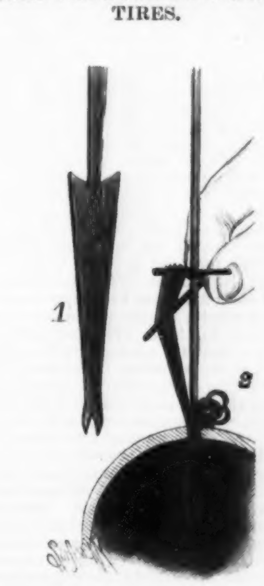
No. 4.



No. 5.—WIRE PLUGGER FOR SINGLE TUBE TIRES.



No. 6.—PLUGGING TIRE WITH RUBBER BANDS.



No. 7.—TIRE PLUGGED WITH RUBBER BAND.

eye of the needle, leaving three thicknesses in the hole. In Fig. 4 the double band is forced well into the hole, and then the band is withdrawn to be cut off close to the eye of the needle, leaving four thicknesses in the hole. By carrying out this system almost any number of thicknesses of bands may be introduced. The process seems exceedingly well adapted for irregular punctures.

Our next cut, No. 7, shows a tool for introducing small rubber bands in quantities. Fig. 2 shows a needle with a small cross piece and notched end. A quantity of small endless bands are strung upon it, their center portions passing over the notched end and their ends being looped over the two extremities of the cross piece. The needle and cross piece are so proportioned as to stretch the bands considerably. After lubrication they are forced into the tire as shown and the looped ends are pushed off the crossed piece. The needle is then

No. 8.—PUNCTURE PATCH MADE OF TAPE.

withdrawn, leaving the bands in the hole, to be trimmed off as desired. Fig. 1 of the same cut shows a needle cut out of a piece of hard wood to be used in an emergency in perfecting this kind of a repair.

A patch repair executed with the well known tire tape is shown in cut No. 8, designed for use especially for bad cases. A patch is built up of tire tape, by cutting short pieces and placing them transversely to each other, batten fashion. If a cut is large enough, such a patch is placed in the interior of the tube and pressed up firmly against the cut by forcing the sides of the tube together. Another such patch is placed outside and the whole is secured by winding the tire tape. Solution may be used to secure the tape in place if the tape is too dry to adhere without it.

Cut No. 9 shows a puncture band, which may be of heavy pure gum rubber or of leather, Figs. 1, 3 and 4. Fig. 1 is arranged to be secured by strings around the tire. Fig. 3 has a buckle and a strap, and Fig. 4 has the well known eyelet and stud catch used on gloves. To apply these, if made of leather, an India rubber patch is first cemented by solution over the puncture, on the outside of the tire, and over it the band is secured.

The band shown in Fig. 4 is of somewhat thick and elastic India rubber, long enough to be wound twice around the tire before being secured, thus producing a very perfect tension. This or other bands can be directly cemented over the puncture, the rubber patch being dispensed with. This is not recommended. As a substitute for the bands a leather shoestring, which is wound tightly over the rubber patch, is excellent. In all these cases the tire should be incompletely inflated, so that when finally inflated the tension is increased.

There are two points relating to the subject to be considered. One is the alleged porousness of tires. Single tube tires in general consist of an inner lining of India rubber, surrounded by a fabric, the latter bedded in and coated with India rubber. The tightness of such a tire depends almost entirely on the maintenance of the integrity of its inner lining. If this is punctured or injured from the inside, air will get into the fabric and following the threads escape in a quantity of minute streamlets, so that when sponged with water minute bubbles will be seen escaping from an indefinite number of places. The tire may be puntured by a nail and the puncture may be mended so as to be perfectly tight, yet the nail may have punctured the inner coating on the opposite side too without cutting through, and this puncture may be enough to start leaks, producing so-called porousness. There is no way of finding the location of such an inner lining puncture.

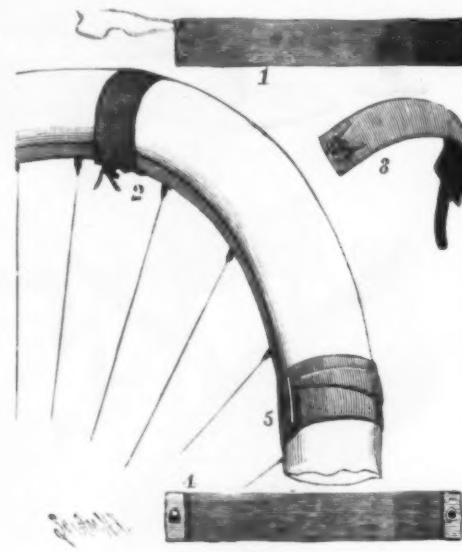
Another point relates to the putting on of a patch by means of rubber solution. The adherence of these patches does not depend on cementlike action of the India rubber, but on cohesion. The best way of doing it is as follows: The surfaces to be fastened together are coated with the solution, which is allowed an hour or more to dry. If possible it is well to give ten to twelve hours. Or, after drying two or three hours, a second, and after a similar interval a third, coating of the rubber may be given to the surfaces, the final drying being as long as possible. When perfectly dry, the surfaces are placed in contact. The instant they touch they cohere and the operation is complete. In mending on the road, where time is an object, the surfaces coated with solution may be dried more rapidly by exposing to the sun and by blowing upon them.

A puncture in a single tube tire may be readily found by immersing the tire in water, and still more simply by wetting the surface with water, using a sponge or even the hand and watching for the escape of the bubbles from the wet surface. It is assumed, of course, that the tire is kept inflated all the time. For burning out a puncture in an emergency a hairpin may be employed, heated by a match.

As a desperate remedy a porous tire may have a longitudinal slit, about six inches long, cut through its inner periphery. At one end a hole half an inch in diameter is made. A weight, such as a nut from a bolt, is tied to a string and it is worked around the tire. An inner tube is drawn by it into the tire. The slit is then laced up, and the tire becomes an inner tube tire. This is not practicable except with tires having a good fabric to hold the lacing.

THE FAUN FOLDING BICYCLE.

IT is considered by many people more than probable, says the Engineer, that if some means can be devised for rendering bicycles more easily handled by railway officials, and if they can be made to occupy less space during transit, large concessions in the way of reduced charges for carriage by rail will ensue. With this ob-



No. 9.—PUNCTURE BANDS.

ject numerous attempts have been made to improve the safety bicycle, and probably the best is that of the Faun Folding Cycle Company, Limited, of Bishopsgate Street Within, London, E. C.

The bicycle devised by this firm is shown very clearly in the accompanying engravings—Figs. 1, 2, and 3. The frame of the machine here shown is constructed in two distinct parts, which are connected by a stout hinge, so that by removing a strong hollow pin, the front half of the machine may be bent back so that the front wheel lies against and parallel with the back wheel, while the handle bars are also hinged, and can be turned down into the position indicated in Fig. 3, after simply removing a bolt on the top.

A machine which we have had an opportunity of inspecting, and which our interested readers will be able to observe for themselves at the forthcoming National Show at the Crystal Palace, loses little, if anything, in point of rigidity, an essential feature, while only a comparatively slight additional weight is necessitated. Although our illustration shows a convertible gentleman's or lady's bicycle, it will be understood that the folding principle can readily be applied to any type of machine.

FIG. 1.

FIG. 2.

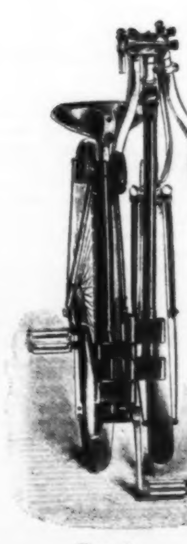


FIG. 3.

THE FAUN FOLDING BICYCLE.

THE FIRST HYDRAULIC CRANE.

SIR Wemyss Reid, in the Nineteenth Century, gives some reminiscences of Newcastle-on-Tyne. One of the most interesting refers to the origin of the hydraulic crane. As a youth (he says) I remember a plain house in Westgate Street, upon the door of which was a worn brass plate bearing the words, "Mr. Armstrong, solicitor." The Mr. Armstrong of forty years ago was an eminently respectable member of his profession. Some good people, it is true, shook their heads when they heard that instead of attending to conveyances and writs and mortgages, he had taken to dabbling in mechanics. Not that way does fortune lie in the profession of the law. But one day I was taken as a boy to see a remarkable new toy—it seemed nothing more—that had been placed upon the Quayside at Newcastle, where a few small steamers and Dutch merchantmen were in the habit of coming with cargo. It looked like a metal box, with some curious handles, not unlike water taps, upon the lid. A good-natured workman turned one of these handles, and lo! as he did so, a great crane hard by rattled its chain, and slowly but surely swung a heavy load into the air. It was like magic. "Now try it yourself," said the man, as he stopped the movement of the crane. Timidly I moved the handle, and straightway the miracle was repeated. At the touch of a child the heavy load was at once borne upward. "It's arl dunne by watter," said the man, "and it's Armstrong, the solicitor, in Westgate Street, that's invented it." That was the first hydraulic crane. "Mr. Armstrong, solicitor," had found his true calling in life. He still kept up the practice of his profession. But he bought a small bit of ground by the side of the Tyne, away from the town, on the Scotswood Road, and there he raised a modest building, within which the manufacture of his new hydraulic machinery was undertaken. From that humble beginning of more than forty years ago has sprung the vast Elswick establishment, which knows only one rival in Europe. Fifteen thousand workmen are busy from day to day at furnace, forge and lathe. Of course the place had begun to make great strides forward before I left Newcastle in 1862. The famous rifled gun had been invented, and was becoming almost as important an article of manufacture as the hydraulic cranes and rams. But since then the development of the establishment has been almost appaling, and I could not recognize the scenes once so familiar. It is "Mr. Armstrong, solicitor," now Lord Armstrong, who has given the impetus to the industrial progress of the Tyne.

Mr. G. A. Henderson, on October 2, 1896, wrote out a political speech on the typewriter as the words fell from the lips of the speaker at the rate of 119 words a minute, thus distancing Miss Orr, who made a record of 98·7 words a minute. The speech was made at Huntington, W. Va.

ENGINEERING NOTES.

Compressed acetylene gas is to be tried for lighting carriages on the London & Northwestern Railway; already it has been experimented with, a composite lavatory carriage, No. 1386, having been run with satisfactory results on the 5:30 P. M. Manchester express. The light, it is stated by the Locomotive Magazine, is beautifully brilliant, being quite an imitation daylight, and the ordinary gas lit carriage looks dull in comparison.

A correspondent, writing to the daily press, states that "he learns, upon inquiry at the respective offices of Sir William Armstrong & Company and Messrs. Whitworth & Company, in London, that the reported amalgamation of the two concerns is an accomplished fact. The new company will, of course, be duly advertised. It may be safely stated that, in any event, there will not be any transference of business from Newcastle, and the probability is that both businesses will be carried on in much the same style as at present."

What is the best material for an engine room floor? asks Power. Attempts are constantly being made to improve upon the ordinary hardwood flooring laid in narrow strips and polished, on the ground that it is slippery and dangerous where a loss of foothold is liable to throw the attendant or visitor into moving machinery—a danger which is liable to be increased in the immediate vicinity of such machinery by the presence on the floor of oil or grease. Strips of rubber or other matting about the engines and dynamos are often used to avert the danger and save the disfigurement of the floor by the spattering of lubricants; but these are makeshifts at the best, become foul from accumulations of oil and dirt, require frequent renewals from wear, and especially when worn are liable to trip the passer and precipitate the very accident they are designed to prevent.

According to a recent article in the New York Herald, the Egyptian government will shortly proceed to excavate the Raiyan Canal, on plans proposed by Mr. Cope Whitehouse, of New York City. The Raiyan Canal is to be 10 miles long, and will connect the Nile River with a tract of 250 square miles of land a few miles southeast of Cairo and 120 feet below the level of the Nile. By draining the surplus flood waters of the Nile into this tract it is estimated that crops worth $70,000,000 can be raised on what is now a desert, and that better control will be given of the Nile floods, with favorable effects on the sanitary conditions of the Lower Nile. Mr. Whitehouse discovered this tract while traveling in Egypt, and, having bought the tract, has had plans for its development before the Egyptian authorities since 1891. It is estimated that the canal will cost $3,000,000.

A German contemporary, comparing the relative cost of producing power from steam and gas, arrives at the following conclusions: (1) Steam engine: 100 kilos. of coal produce, per hour, 100 times 7,500 heat units, or 750,000, of which 60,000 render actual service. This corresponds to the production of 95 horse power. As 100 kilos. of coal cost 1·20 marks, one horse power per hour would cost $\frac{120}{95} = 1{\cdot}26$ pfennigs. (2) Gas motor: 100 kilos. of coal produce from 27 to 35 cubic meters of gas. In the average, 30 cubic meters, which contain 30 times 5,200 = 156,000 heat units, of which 20 per cent. = 31,200 heat units, render actual service, corresponding to 49 horse power per hour. As 30 cubic meters of gas cost 3 marks, one horse power per hour would cost $\frac{300}{49} = 6{\cdot}12$ pfennigs.

An improved Howell automobile torpedo has been lately tested by the United States government and the results are highly satisfactory, says the Engineer. The new torpedo is 14½ ft. long, 17 in. in greatest diameter, has a launching weight of 1,130 lb., with a reserve buoyancy of 20 lb. and an immersed displacement in sea water of 1,150 lb. It carries a charge of 174 lb. of guncotton. The mean speed over a range of 400 yards is 33 knots; over a 600 yard range, 30 knots; and over 800 yards, 28·5 knots. The extreme effective range for regular service is 1,000 yards. Instead of being propelled by compressed air stored in the torpedo itself, as in other types, the Howell torpedo has a turbine motor attached to the launching tube, which gives an exceedingly high speed to a heavy steel flywheel within the tube; the stored up energy of this flywheel is then transmitted to two propellers by gearing. The torpedo is launched by indirect gunpowder impulse, with the flywheel revolving at a speed of about 10,000 revolutions per minute. Out of 346 shots, with the launching tube 2¼ ft. above the water, there were 332 hits, 10 misses and 4 accidents; with the tube 9½ ft. above the water there were 63 hits out of 69 shots. The target was a rectangle 21 yards long by 1 yard wide, 8 ft. below the water surface.

The corrosive power of pure water on new or unscaled boilers was well illustrated in the city of Glasgow, when a new water supply was introduced from Loch Katrine, one of the purest waters in the world which are available for city consumption. The former supply had been poor and calcareous, and old boilers were much coated with lime scale. To the dismay of the users, those who had put in new boilers or new tubes found them rapidly corroding, while the old scaled and coated boilers remained as before; those, too, who had removed every possible trace of old incrustation from their old boilers by mechanical or chemical means, intending thus to get, as they expected, the full benefit of the pure water, were also badly troubled by corrosion; and even the old boilers, as the scale was gradually removed by the unvaryingly soft and pure water from the lake, were more or less corroded when no means were taken to prevent it. It was found, however, in this case, that introducing a little lime from time to time—enough to give the boilers a slight calcareous coating—usually prevented the corrosive action of the water; then, again, in the course of time, the effect produced was that the lime, organic matter and iron oxide skin united in forming a protective oxidized surface which prevented further corrosion.

ELECTRICAL NOTES.

The town, chief suburbs, and harbor of Malta were recently lighted by electricity for the first time.

According to English court records, which are reliable, Dr. John Hopkinson was paid very nearly $100,000 for his patent for the three-wire system of distribution.

A telephone has just been placed in the pulpit of St. Michael's, Chester Square, London, in order that Canon Fleming's sermons may be heard by the inmates of the neighboring hospitals and by invalid parishioners. Similar devices have been in use in the United States for many years.

To light up the new Southeastern corridor train, each carriage is equipped with its own dynamo and accumulators, so that it is completely self-contained. The novelty of the system, according to the Electrical Engineer, is the means of getting constant voltage independent of the speed at which the train is going.

In St. Louis, Missouri, it has been proposed to substitute incandescent lamps for arc lights in the streets; but the citizens object, as St. Louis is about the best lighted city in the world, and incandescent lamps are not suited for illuminating streets. Each arc lamp costs $75 per annum, about the lowest rate in the United States—half the price paid in New York.

A central electric light and power station for coal miners' use is said to be planned by a number of coal operators in Jackson County, O. In the Wellston district fifteen mines will be thus supplied and fourteen in the Coalton district. The substitution of electric machines for hand mining, it is expected, will diminish the trouble from strikes, to which Jackson County has been particularly subject.

Electric power has been used for the last five months in driving two large paper machines, respectively 90 and 102 inches in size, in the works of the Cliff Paper Company at Niagara Falls, with entire success. One 150 horse power generator is capable of driving both machines. The great advantage of electric driving is its steadiness and uniformity of speed, which allows the machine tender to keep his paper to uniform weight without difficulty. The output of the machine is from 300 to 350 feet of paper per minute, or 25 tons per day.

A story comes from Newark, N. J., to the effect that Louis H. Gamp, an electrician of the Newark Electric Light and Power Company, a few days ago touched with his arm a wire carrying a 6,000 volt current, receiving a severe flesh burn, says the Electrical World. He was stiffened out but did not lose consciousness. On examination of his body it was found that a piece of metal which Gamp had in one of his trousers pockets had left a mark upon his flesh, and around the edge of the sole of one of his feet was a row of small burns corresponding to the nails in his shoes.

One of the largest electric plants in this country will soon be established at York Haven, Pa., at a cost of about $2,000,000 or $3,000,000, and will be about 20,000 horse power. It will distribute a current of electricity throughout the near-by towns, such as Harrisburg, Lancaster, York, Manchester and all the towns within a radius of thirty or forty miles. It is said that the plant will be the means of the establishment of three or four large mills at York Haven. Early in the spring about 2,000 men will be put on the works in order to hasten completion. It is thought that it will take about three years to complete the plant.

The American Siemens & Halske Electric Company have introduced a somewhat novel system of armature ventilation. The device is described by the Electrical World, and is fitted to the large ring cores of the type largely used by the Siemens firm. Between every two of the arms a hole is left in the core for ventilating purposes, and at equal distances from each other in the construction of the armature are ventilating spaces with which these ventilating holes communicate, and thus the surface cooled by the current of air is increased. The method of forcing the air into the holes is unique and different from that used on any other existing machine. Driven tightly in each hole is a pipe of precisely the same shape as a clay tobacco pipe, except that the internal dimensions are much larger. One set is turned in such a direction as to scoop the air as the armature rotates, and the other set, which is on the star side, is arranged to point outward, and the powerful draught caused by the centrifugal fan action of the arms draws the heated air out, and there is thus maintained a constant circulation of air within the core of the armature. It would be interesting, though not specially to electrical engineers, to know what are found to be the best angles at which to set the indraught and outdraught scoops.

It is stated that part of the new plan for prevention of raids by Apache Indians in Arizona includes the construction of a military telegraph line in that territory, to be built by the signal service corps, says the Boston Journal of Commerce. A single line of wire supported on iron telegraph poles will comprise the proposed work. The material to be used is what is left of the old military line between Carthage, N. M., and Fort Stanton, N. M., a distance of ninety miles. Part of this material was used to erect the line put up some time ago between Cedar Spring and Mammoth, Arizona. The Indians rarely resort to cutting telegraph wires, and consequently the only danger to lines is the destruction of the poles and the insulators. Campers and overland travelers in that country, where wood is so scarce, might be tempted to cut down the wooden poles for use in burning. Consequently, iron poles will be employed. It has always been a favorite diversion of humorously inclined cowboys to try their marksmanship by shooting down the glass insulators. There is an act of Congress which makes this sport an offense, and linen notices of this law, in English and Spanish, will be attached to the poles. It was found that the sandstorms, which are of frequent occurrence in the country, would wear away even the iron posts, so they will be covered with tar, to which the sand will adhere, the coating thus formed making a permanent defense against the action of flying sand. Heliographic stations will also be established in connection with telegraphic ones, by means of which the whole country can be kept under the eye of the government.

MISCELLANEOUS NOTES.

The flags to be hoisted at one time in signaling at sea never exceed four. It is an interesting arithmetical fact that, with eighteen various colored flags, and never more than four at a time, no fewer than 78,642 signals can be given.

The Times of India states that "one of the first acts of the Shah of Persia has been to prohibit the export of lambskins, commonly known as 'astrakhans,' from Persia, on July 14 last. This is considered a wise step, as the present condition of the country can ill afford the wholesale destruction of new-born lambs, although the interdict in question will cripple for a time a not unimportant channel of trade with Russia."

The brush trade is full of deceptions. An experienced hand will, by touch, tell if a broom or brush is all hair or a mixture. But if ever in doubt, pull out or cut off a suspicious hair and apply a match. However well doctored, the deception will be shown at once. Hair will burn, rolling up ball-like, with the well-known smell of burned hair, while a vegetable substitute will consume, leaving the charred portion like a burned match.

The Australian redwood pavement that was laid a year ago on West Twentieth Street, between Broadway and Fifth Avenue, New York City, is said to be a failure, says the Bicycling World. It was put down as an experiment, with the view of getting the city to adopt it on thoroughfares where the traffic is not very heavy. Numerous complaints have been made against the pavement ever since it was laid. The trouble seems to be that when the blocks are wet horses are unable to secure a footing on them, and when driven at a good rate, as soon as they strike the wet wood pavement they go floundering all over it. To prevent accidents, it has recently been covered with a coating of sand.

The city of Los Angeles has just come into possession of land which may become one of the most interesting pleasure grounds in the world, says Garden and Forest. The tract of three thousand acres is situated along the Los Angeles River, about a mile north of the city limits, and comprises a rich diversity of soil and surface. It has been known as the Rancho los Feliz, the property of Griffith J. Griffith, Esq., who has presented it to the city of his adoption with the single restriction that if a charter is granted for a railroad to the park from the town a single fare shall be limited to five cents. Part of the land lies within what is called the frostless belt, and it rises over foothills and a mountain slope, from whose summits there is a magnificent view, including the city and the sea. Altogether it is a royal gift, and it is to be hoped that the city will appreciate it and see that the natural beauty of the place is not marred by the handiwork of unskilled park makers.

Around the world in thirty-three days is the possible pace set by Prince Hilkoff, the Russian imperial minister of ways and communication, now officially studying American railway methods. To make the circuit in this time modern fast ships and railway trains are alone considered; but with these available on the routes specified he gives the time as follows: New York to Bremen, 7 days; Bremen to St. Petersburg by rail, 1½ days; St. Petersburg to Vladivostock, by rail at thirty miles per hour, 10 days; Vladivostock to San Francisco, via Hakodate Straits, 10 days; San Francisco to New York, 4½ days. The present shortest time for circuiting the globe is given as follows: New York to Southampton, 6 days; Southampton to Brindisi, via Paris, 3½ days; Brindisi to Yokohama, via Suez, 42 days; Yokohama to San Francisco, 10 days; and San Francisco to New York, 4½ days, or 66 days in all.

A statistician has learned that the annual aggregate circulation of the papers of the world is calculated to be 12,000,000,000 copies, says the Northeastern Lumberman. To grasp any idea of this magnitude we may state that it would cover no less than 10,450 square miles of surface, that it is printed on 781,241 tons of paper, and, further, that if the number 12,000,000,000 represented, instead of copies, seconds, it would take over 333 years for them to elapse. In lieu of this arrangement, we might press and pile them vertically to gradually reach our highest mountains. Topping all these, and even the highest Alps, the pile would reach the magnificent altitude of 490, or, in round numbers, 500 miles. Calculating that the average man spends five minutes reading his paper in the day, we find that the people of the world altogether annually occupy time equivalent to 100,000 years reading the papers.

One of the purposes of the census is to tell us what we die of, at what ages we are most susceptible of fatal disease, and the proportion of deaths according to sex and according to color, says the Independent. In the first place, according to the Report on Vital Statistics for the year ending May 31, 1890, there are considerably more than a hundred diseases mentioned as the cause of death, not including some varieties difficult of classification. These 110 or more diseases are grouped in twelve classes. In the second place, the record for the year was 875,521 deaths. Of these about 197,000 were of persons under one year of age, and 307,562 of persons under five years of age. In the subsequent periods, extending up to ninety-five, it appears that the most fatal ten years is that lying between the ages of fifteen and twenty-five, followed closely by the period twenty-five to thirty-five. There are fewer deaths in the period forty-five to fifty-five than any other between fifteen and seventy-five. Thirdly, the number of deaths is greatest uniformly among males. Of the total deaths, 463,044 were of males and 402,900 of females. As there are upward of 1,500,000 more males in the population than females, it is, of course, natural that the number of deaths should be greater in the former. Fourthly, the most fatal disease is, as most would guess, consumption. It carried off 102,199. Next comes pneumonia, 76,496 victims; then diarrheal diseases, with 74,711; diseases of the heart, 44,959; diphtheria, 27,815. Smallpox, which is such a terror to people unaccustomed to city life, was responsible for only 398 deaths, while measles was fatal in over 9,000 cases, whooping cough in 8,432, and alcoholism in 2,657. Cancer carried off 18,536, simple old age 16,591, sunstroke 475, and surgical operations 865.

SELECTED FORMULÆ.

Non-setting Gelatine.—There are many purposes for which a non-setting gelatine is of considerable value, the direct carbon or pigment printing being one. Long, long ago, so long as to be almost forgotten, Maxwell Lytte, we think, introduced a method of producing one, under the name of "meta gelatine," but the following, recommended by Dr. F. Mallmann, will be found both simpler and better :

Water	1,000 parts.
Chloral hydrate	250 "
Gelatine	400 "

Soak the gelatine in the water and apply a gentle heat till dissolved, and then add the chloral.—American Amateur Photographer.

Paste Stove Polish.—

(1) Plumbago	2 pounds.
Water	8 ounces.
Turpentine	8 "
Sugar	2 "

Knead thoroughly and keep in tin boxes. Apply with a brush.

Here are several other formulas :

(2) Mix 2 parts of black lead, 4 parts of copperas, and 2 parts of bone black, with water, so as to form a creamy paste. This is an excellent polish, as the copperas produces a jet black enamel, causing the black lead to adhere to the iron.

(3) Moisten plumbago with turpentine in which resin has been dissolved, to make it adhesive, and subject it to strong pressure in appropriate moulds.—Pharmaceutical Era.

Wash Bluing Tablets.—

TABLETS OF THE FIRST QUALITY.

Best (superfine) ultramarine	40 parts.
Ordinary ultramarine	20 "
Sodium carbonate	40 "
Glucose	12 "

Mix and make into tablets as directed further on.

INFERIOR TABLETS.

Ultramarine, second quality	50 parts.
Sodium carbonate	50 "
Glucose	12 "

Still cheaper bluing may be made by using less ultramarine and more sodium carbonate, or by using cheaper coloring material (the so-called blau-erde), but the above will answer for the best and second-class trade.

The glucose is diluted with water to 16° Baumé, and, if the tablets are to be made quite hard, either gum arabic, gelatine or dextrin should be added. As tablets made without any addition very easily contract moisture, an admixture of one or the other of the substances named is recommended. It is possible that cylinders might prove more acceptable than tablets. These should be wrapped in linen, or put into linen bags, so that in use the bag can be hung up in the water, thus giving a solution that will not need straining under any circumstances.—Drogisten Zeitung.

Copying Ink.—

1. Rain water	2 gals.
Gum arabic	¼ lb.
Brown sugar	¼ "
Clean copperas	¼ "
Powdered nut galls	¾ "

Bruise all and mix, shaking occasionally for ten days, and strain. If needed sooner, let it steep in an iron kettle until the strength is obtained.

2. Boil 33 parts each of coarsely powdered gall nuts, extract of logwood and bruised tormentil root in 500 parts of water, and strain the fluid. Next dissolve 180 parts of sulphate of iron and 33 parts of alum in 250 parts of water; add this solution to the above fluid, and dissolve in it by boiling 1 drachm of indigo carmine, 1 ounce of gum arabic and 2½ ounces of white sugar.—Era.

Glue Paste.—

FOR CLOTH BOOKS, ETC.

(a) White glue	4 ounces.
Cold water	8 fl. ounces.
(b) Corn starch	4 ounces.
Cold water	8 fl. ounces.
Mix and pour into	
Boiling water	16 fl. ounces.

Soak the glue four hours in the cold water, then dissolve in a glue pot; mix with the starch paste, and gently heat for about ten minutes. If wanted elastic, add 4 fluid ounces of glycerine.—Bulletin of Pharmacy.

Moth Powder.—

Powdered camphor	1½ ounces.
Powdered black pepper	4 drachms.

Well mix, and sprinkle where the moths are troublesome.

Another very good moth preventive is naphthalin. It can be obtained either in cakes or in small crystals, and is a good disinfectant.

Bicycle Tire Cements.—

1. To those who feel a longing to make their own tire and repair cement, the following will be found to be an excellent formula :

Crude rubber	½ ounce.
Resin	1 "
Beeswax	¼ "
Carbon disulphide	½ pint.

Macerate the rubber in 4 ounces of bisulphide for 24 hours; then dissolve the resin and beeswax in 4 ounces of the solvent and mix the two solutions.

2. An excellent cement for cycle tires is made of :

Bisulphide of carbon	160 parts.
Gutta percha	20 "
Caoutchouc	40 "
Isinglass	10 "

This cement is dropped into the crevices after they have been properly cleaned. If the rent is very big, apply the cement in layers. Bind up the rubber tightly with thread, let it dry for twenty-four to thirty-six hours; cut off the thread, and remove the protruding cement with a sharp knife, which must previously have been dipped in water.—Leitschrift.

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